A SOCIO-ECOLOGICAL APPROACH TO COMBAT DESERTIFICATION FOR SUSTAINABLE FUTURE

EcoFuture

Work Package 5

Deliverable 5.2 Identifying conflicts, gaps and proposing changes

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Executive Summary

The Jordan Valley (JV) is a critical region where the interplay of Water-Energy-Food and Ecosystem (WEFE) dynamics presents both challenges and opportunities for sustainable development and climate change mitigation and adaptation. The impact of climate change has already been felt in the JV, with recent rainfall records showing that the area is under imminent threat of desertification. In such a transboundary river basin with acute nexus problems and a long history of conflicts, it is essential that conscious efforts are made to pluralize the debate and actively encourage stakeholders' empowerment, participation and fair collaboration in strategic planning.

This report outlines the PRIMA EcoFuture's project prototype framework for participatory strategic planning in the WEFE nexus, which has been developed in the context of the transboundary JV case study. EcoFuture's nexus approach gives emphasis to decentralised but coordinated decision making as the source of solutions, based on a clear understanding of the challenges faced. The unique synthesis of the project's consortium has achieved the continuation of the project despite the ongoing political conflict in the region. The methodologies and overall framework presented in this paper may be replicated and scaled up across the region and in other regions with similar arid climates and challenges around the world.

The EcoFuture project's approach is divided into two distinct phases. Phase A necessitates stakeholder input, while Phase B involves the co-design of a strategic plan for climate change adaptation and mitigation, with stakeholder participation. This report primarily focuses on Phase A, which has already been implemented in the JV. Phase B will be executed in the subsequent years of the project, with the comprehensive outcomes to be documented in a future report. The proposed framework is designed to be adequately generic at the conceptual level, allowing for methodological customization to address the unique characteristics of the case under study.

The rationale for the inclusion of each methodological component within the framework is detailed below. Through a preparatory **WEFE Nexus background data collection** step, the data that will inform the core methodologies of the framework are gathered. Additionally, **WEFE mathematical models** that simulate the water and energy resources of the studied area may be used to quantify the current, as well as the future conditions and demand. These 'desk studies' need to be combined with a series of participatory assessment approaches. First, **Participatory Systems Mapping** is proposed as a strategic planning tool to shift from individual (or sectoral) perspectives to the definition of a holistic system picture, based on the WEFE Nexus approach; ultimately identifying suitable actions to drive the system towards sustainability. Next, **Community Capacity Assessment (CCA)** may be used to explore whether the community has the skills and assets to tackle the challenges it faces, as well as to identify the kind of support the community needs to further develop its capacities and achieve certain goals. Finally, **Gap analysis**

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(GA) is a process originating in management literature and involves the comparison of actual performance with potential or desired performance. In the context of WEFE strategic planning, the gap between these two performances, may guide the selection of a program of measures to address WEFE challenges and reduce this gap. While GA has not yet been applied in WEF/WEFE nexus literature, we consider it an essential step for linking all the previous methodologies with the preparation of the WEFE alternatives to be evaluated in phase B of the framework.

This conceptual framework has been adopted for implementing Phase A of the project in the JV. A series of stakeholder meetings have been conducted in the three territories (Jordan, Palestine and Israel) as part of the National Living Labs to identify the WEFE challenges, the leverage points and their relative priorities. We used the CLD methodology to illustrate and discuss with the stakeholders the complexity and the interdependence of the WEFE sectors and the interlinkage of the main challenges. Then, in a Transnational Living Lab setting, the capacity of each community to address these challenges, and the main barriers that need to be overcome was assessed through Capacity Factor Analysis, which is a method for conducting CCA. Once this was completed, performance gaps have been assessed for the three territories by identifying a series of key performance indicators (KPIs) and estimating the gap between the current state and the objective.

These stakeholder engagement assessments have been supported by a series of mixed-method studies that aimed, on the one hand, at qualitatively mapping the WEFE Nexus (Governance, socio-ecological and WEFE resources mapping), and on the other hand, at quantitatively modelling the hydrologic system, the water allocation and the energy resources in the JV. These studies provided the quantitative and qualitative base data for the assessment of the gap in each territory. Subsequently, the gap analysis presented in a systematic manner the gaps in the 'WEFE performance' of the three territories, facilitating comparative assessment between the territories and among different goals.

For Jordan and Palestine, the highest priority goals are related to water, i.e. to 'Ensure water quality' and to 'Meet water demand for irrigation'. The next priority for both Jordan and Palestine is to 'Ensure agricultural development'. 'Ensure soil quality' is also included in the list of the top goals from the Jordanian perspective, while 'Ensure renewable energy availability' is included in the list from the Palestinian perspective. On the contrary, for Israel, the water-related issues have been given lower priority, therefore they are not systematically presented in the gap analysis. This does not mean that the gap for these goals would be smaller in Israel. In fact, Israel is in a better current state but has set more ambitious objectives regarding these goals. However, considering the adequate current performance regarding these goals, other more pressing issues have been given higher priority by the Israeli stakeholders. Specifically, 'Climate change adaptation and mitigation', 'Development stresses mitigation', 'Biodiversity loss mitigation' and

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'Renewable energy availability' have been given the highest priority by the Israeli stakeholders and are included in the gap analysis.

For each of the aforementioned goals, the gaps of the respective countries that assign high priority to this goal, are comparatively presented and discussed. Overall, the priorities as well as the capacities and gaps across the three territories of the Jordan Valley have proved substantially different. While the Jordanian and Palestinian stakeholders mostly share common challenges and capacities, the image formed for the WEFE nexus in Israel differs substantially. Additionally, Israel may present wide gaps for some indicators but this is also due to its more ambitious objectives, which are partially based on its higher capacity to reach them, as it has been assessed in the previous phase. On the other hand, the wide gaps that are present for Jordan and especially Palestine, are mainly due to the adverse current state that they experience regarding the examined indicators. Therefore, the specific solutions and strategies that will be proposed at the next phase of the project should consider and reflect these disparities.

The GA methodology implemented here functions as a preparatory step for the assessment and selection of specific WEFE solutions to address the challenges in the region. The outcomes of the GA will inform the decision criteria, indicators and weights that will be needed for the Multi-Criteria Decision Analysis application in the next phase of the project. At this stage, based on the recorded gaps, and on the drivers identified during the CLD analysis, a first set of potential solutions has been formulated. Specifically, the goals/challenges and their drivers have been associated with potential NBS and strategies applicable to the JV. These NBS and strategies have been informed by the methodologies developed in the Prima project 'LENSES' and the H2020 project 'ThinkNature' for the design of NBS.

The next phase of the project will utilize the recommendations and outcomes of all studies to co-design with the relevant stakeholders appropriate WEFE alternatives for the Jordan Valley. Overall, it is crucial to design interventions that not only address the identified priorities but also consider the existing differences in capacities. A comprehensive approach should include, among others, targeted training programs, improved access to modern technologies, and enhanced understanding of regulatory frameworks.

Concluding, we need to note that the implementation of this framework took place under the most adverse conditions, considering the ongoing Gaza war. Nevertheless, thanks to the uninterrupted commitment of the consortium partners, it has provided a systemic and inclusive overview of the WEFE nexus in the region, of what are the most important challenges and capacities for each territory, their drivers and leverage points, and of the directions in which the forthcoming solutions and strategies should move.

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1. Introduction

In a time of acute ecological, socio-economic and geopolitical crises, research is expected to take on a new role for actively pursuing sustainability and producing actionable knowledge to tackle real-world sustainability challenges (Ravetz, 2006). The complexity of real-world problems necessitates a research approach that recognizes the interdependence of systems and incorporates diversity of viewpoints and sources of knowledge – within and beyond academia. Such a research approach is becoming the cornerstone of sustainability science, as an emerging transdisciplinary research paradigm (Troullaki et al., 2021).

Among the most pressing contemporary challenges is ensuring the sustainability and security of supply of essential resources, such as water, food and energy. The systems related with the life cycle and governance of these resources are highly interconnected, which has led to the development of nexus concepts in research and policy, for analyzing interrelationships, strengthening synergies and minimizing trade-offs across these sectors (Karnib, 2016; Moreira et al., 2022; Baratella et al., 2023). Particularly, the Water-Energy-Food-Ecosystem (WEFE) nexus approach highlights the interdependence of water, energy and food security, as well as the ecosystems underpinning that security (European Commission et al., 2021a; Vanino et al., 2024). Nexus approaches have thus become a popular framing for research that aims at addressing complex social-ecological challenges, that span across those sectors (Hoolohan et al., 2018), at local (Lilli et al., 2024; Maragkaki et al., 2024), regional or global scales.

The nexus has proved to be an adept and powerful concept for bridging the science-policy gap (Hejnowicz et al., 2022); as long as stakeholders are meaningfully engaged in the planning process. Participatory approaches are widely recognized in nexus research as the most effective way to identify trade-off solutions between divergent interests. Including stakeholders helps ground outputs in reality, making results more relevant for policy makers (Lilli et al., 2020; Sušnik & Staddon, 2022; Masiero et al., 2024). Actually, "*non-academic organisations have been working across the water–energy–food nexus in practice, and for some time, without needing to name it as such. So, there is potentially much to be learnt through interaction with stakeholders operating in this space*" (Hoolohan et al., 2018). "*This approach is also important to guarantee that social and local aspects of sustainability are taken into consideration, while giving the participants opportunity for self-reflection*" (Moreira et al., 2022).

Recognizing the importance of stakeholder's experiences, as well as their role in governing these sectors, has led to increasing popularity of transdisciplinary approaches in nexus research *(*Harris and Lyon 2014; Stirling, 2015)*, "at least in theory"* (Hoolohan et al., 2018, p. 1416). Despite this acknowledged potential, the active engagement of stakeholders for the co-creation of knowledge within the nexus research agenda is still limited to date (Hoolohan et al., 2018; Sušnik & Staddon, 2022; Baratella et al., 2023).

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At the same time, mixed-method approaches from a variety of disciplines are needed to accommodate the complex, non-linear nature of nexus challenges (Hoolohan et al., 2018). For this, better harmonization of quantitative modelling with social science approaches is required (Hejnowicz et al., 2022; Sušnik & Staddon, 2022). While the integration of social science methods in nexus research is actually gaining ground (Sušnik & Staddon, 2022), there are still very few studies that have implemented such a mixed-methods research design combined with active stakeholder engagement in real-world nexus problems.

Consequently, there is both a lack of integrated frameworks for mixed-methods participatory planning in the WEFE nexus and a lack of relevant experience from their actual implementation in the field (Stylianopoulou et al., 2020). It has been argued that the need for common, replicable tools for nexus research is unlikely to be resolved as "*there is no overarching framework or approach that can adequately satisfy the different needs and requirements of every study*" (Sušnik & Staddon, 2022). However, we argue that when performing (WEFE) nexus research within specific geographical regions, e.g. the Mediterranean, a transferrable, replicable methodology to apply in other areas within the region will be extremely useful.

This paper outlines an innovative conceptual and methodological framework for implementing strategic planning in the WEFE nexus with the active engagement of stakeholders throughout the planning process. After presenting the framework at conceptual level, its implementation through specific methodologies in the case of the Jordan Valley (JV) is presented in detail. The work has been conducted as part of the PRIMA research project EcoFuture, whose overall objective is to provide security of supply for the major resources (water, energy, food and ecosystems) to the people of the JV by developing an effective climate change adaptation plan, based on existing technologies, considering the social and economic priorities of the three involved countries (Jordan, Israel and Palestine). The first phase of this strategic plan aims at identifying the conflicts, gaps and proposing changes with stakeholder engagement.

The JV is a critical region where the interplay of WEFE dynamics presents both challenges and opportunities for climate change mitigation and adaptation, and sustainable development. The WEFE nexus emerges as a vital framework in this context, emphasizing the interconnectedness of these sectors and the need for a holistic management approach to achieve socioeconomic welfare for the people of the valley. The JV is actually considered a hot spot regarding the impacts of climate change, with recent rainfall records showing that the area is under imminent threat of desertification. For example, precipitation in the North Ghor station was reduced from 395 mm in 1982 to 351 mm in 2021 (11% reduction) and in Mid Ghor from 338 mm in 1982 to 224 mm in 2021 (34% reduction) while the average temperature has increased by 1.9^{o}C in both stations during the same period (Deliverable 1.1). The impacts of climate change are expected to be more severe, necessitating immediate adaptation and mitigation measures to be implemented.

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Despite the relatively small size of the JV, it is shared by three countries -Jordan, Israel, and Palestine, which have been engaged in a century-old conflict culminating in the ongoing war in Gaza. An effective strategic plan, however, requires regional collaboration, all the more as the legislations regulating the WEFE resources in these counties are different. To this end, the Palestinian, Jordanian and Israeli partners of EcoFuture comprise a unique group of entities with proven record of collaboration between themselves, as well as with the regulators in all countries and relevant local stakeholders. They are developing a stakeholder-driven, bottom-up integrated strategic plan that is based on a common understanding of the local idiosyncrasies regarding the WEFE nexus. The team of the Technical University of Crete as coordinator, an outsider to the JV, has extensive engineering experience in solving earth science problems. This is coupled with key socio-ecological skills that can catalyze consensus building and facilitate the development of integrated, win-win alternatives. The building of this consortium is the ultimate socio-ecological innovation of the project, and, until now, the main success factor for the continuation of the project under the current war conditions.

Overall, EcoFuture's nexus approach emphasizes decentralized but coordinated decision making as the source of solutions, based on a clear understanding of the challenges faced. The framework presented in this report has facilitated the implementation of a participatory strategic planning process in the JV and aspires to be replicable in other real-world WEFE nexus projects, particularly in the Mediterranean region.

2. Methodology

2.1 A conceptual framework for transdisciplinary strategic planning in the WEFE nexus

The proposed framework, illustrated in Figure 1, is designed to be both general and replicable, allowing for methodological customization to address the unique characteristics of the case under study. The approach is divided into two distinct phases. Phase A necessitates stakeholder input, while Phase B involves the co-design of the Strategic Plan for climate change adaptation and mitigation, with stakeholder participation. This report primarily focuses on Phase A, which has already been implemented in the JV. Phase B will be executed in the subsequent years of the EcoFuture project, with the comprehensive outcomes to be documented in a future publication. The rationale and suitability of each component within Phase A of the framework are detailed below.

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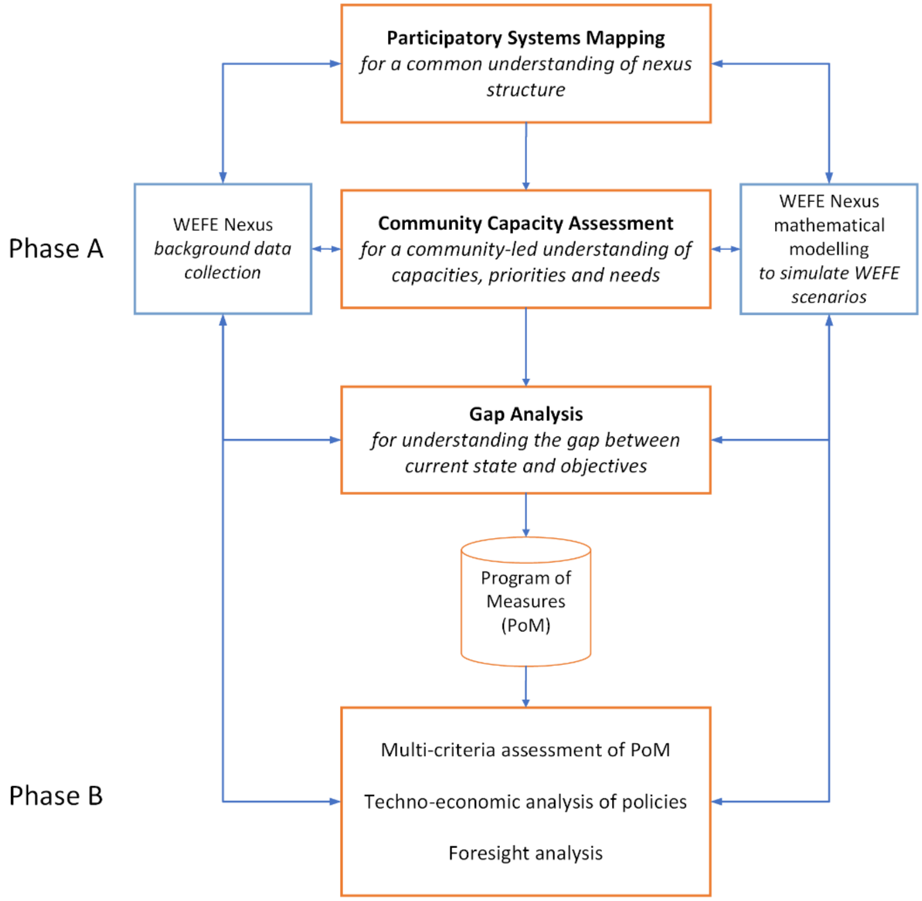

Figure 1. A synthesis of methodologies for transdisciplinary strategic planning in the WEFE nexus

- **WEFE Nexus background data collection**: Through this preparatory step, the data that will inform the core methodologies of the framework are gathered. Comprehensive methodologies tailored to capture the unique challenges and priorities of the studied system, the status of the WEFE resources, as well as the main actors and the assessment of their interest in the system, may be used. Indicatively, this step may include the mapping of WEFE resources in the studied region, socio-economic and social-ecological mapping, governance mapping and stakeholder analysis. This is a significant step, as the quality of the collected background data will directly affect the quality of the framework's outcomes.
- **WEFE mathematical models**: A thorough understanding of the water and energy resources of the studied area is a prerequisite for a compehensive gap analysis of the WEFE Nexus. Mathematical models that simulate the hydrologic budget, the water allocation system of the JV and the energy supply may be used to quantify the current status, as well as the future conditions and demand in the area.

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- **Participatory systems mapping**: While quantitative approaches are essential to understanding how WEFE systems respond, such quantitative models must be backed up by sound conceptual or causal models that describe the system structure. Participatory systems mapping is an essential component in transdisciplinary research and is increasingly used in strategic planning. Within nexus literature, it is recognised as a valuable tool to shift from individual (or sectoral) perspectives to the definition of a holistic system picture - based on the WEFE Nexus approach - ultimately identifying suitable actions to drive the system towards sustainability. In this direction, Participatory Systems Mapping is considered as an effective and straightforward methodological approach to: i) support better understanding of the WEFE systems under investigation, ii) help building a shared understanding of the main challenges for the area, as well as of the most important dynamics that can affect those challenges; iii) help in the identification of leverage points and in the design of policies and actions for a sustainable Nexus management; iv) help understanding system state and potential evolution under different (future) conditions; v) convey nexus dynamics, explore trade-offs, and communicate multidimensionality and interaction through the visualisation of the nexus; vi) facilitate and encourage stakeholder engagement in strategic planning processes (Hoolohan et al., 2018), and enhance a cross-sectoral knowledge fertilization process (Giordano et al., 2024).
- **Community capacity assessment** (CCA) is a community engagement and empowerment approach that seeks to support community development and the strategic planning process. The concept of 'community capacities' has become a core concept in community-based programs in recent years (Gamo and Park, 2022; Lee, 2021). Community capacities can be broadly defined as the resources a community has that potentially can be used for community development and transformation towards sustainability. CCA may be considered as a family of approaches used to evaluate community capacities, and different definitions and categorization of capacities may be adopted (Birgel et al., 2023). In the context of WEFE strategic planning, CCA may be used to explore whether the community has the skills and assets to tackle the challenges it faces, as well as to identify the kind of support the community needs to further develop its capacities and achieve certain goals.
- **Gap analysis** is a process originating in management literature and involves the comparison of actual performance with potential or desired performance. It has recently been introduced in water studies by the Water Framework Directive as a method that "*paves the way to the preparation of the programme of measures*" for the improvement of water ecosystems (WATECO, 2003; Pellegrini et al., 2023). The selection of the package of measures to be evaluated, in fact, is based on the distance between the baseline

scenario and the objectives. "*Only if a clear link is established between the identified gap, its determinants, and the ensuing pressures is it possible to assess to what extent measures can improve the state of water bodies and, in turn, reduce the gap*" (Pellegrini et al., 2023). This distance is measured through the selection of relevant indicators that correspond to the identified WEFE challenges/goals. These indicators, which are used for describing the current and target state of the WEFE nexus and measure the gap, may also be used later in the strategic planning process for assessing the WEFE alternatives. In fact, "*the identification of relevant indicators and target values to be used for assessing trade-offs and synergies is among the current issues with regards to the use of the nexus approach in the sustainability context*" (Estoque, 2023). For all the above reasons, while gap analysis has not yet been applied in WEF/WEFE nexus literature, we consider it an essential step for linking all the previous steps/methodologies with the preparation of the WEFE alternatives to be evaluated.

Phase B of the methodology comprises i) the identification of a program of measures to address the WEFE nexus challenges identified by the stakeholders, ii) conducting a multi-criteria assessment of the measures coupled with techno-economic analysis of the water and agricultural policies, which will then feed into iii) the foresight analysis, where a strategic plan to combat desertification will be co-designed with the stakeholders.

2.2 Case study description

The Jordan Valley (JV) is a critical region where the interplay of water, energy, food, and ecosystem dynamics presents both challenges and opportunities for sustainable development and climate change mitigation and adaptation. The valley's unique geographical and climatic conditions have historically made it a focal point for agriculture, requiring efficient water management strategies to adapt to its arid climate.

Water scarcity in this region is acute, with sources such as the Jordan River and Yarmouk River and underground aquifers under increasing pressure from over-extraction and pollution, directly impacting agricultural productivity and food security. Energy is another critical component, heavily intertwined with water through the energy-intensive processes of water pumping, treatment, and distribution, as well as in agricultural operations and food processing. The food sector in the JV is highly dependent on the sustainable management of water and energy resources, with agriculture accounting for a significant portion of employment and food supply in the three territories yet facing the challenges of limited water availability and the need for energy-efficient technologies.

The ecosystem of the JV, characterized by rich biodiversity and unique habitats, plays a crucial role in supporting agricultural activities, providing ecosystem services such as pollination, pest control, and soil fertility. However, these ecosystems are under threat from overuse of natural resources, habitat destruction, and climate change impacts, necessitating integrated approaches to management. The WEFE nexus emerges as a vital framework in this context, emphasizing the interconnectedness of these sectors and the need for a holistic management approach to achieve socioeconomic welfare for the people of the valley.

The geographic scope of this work is confined to an area that extends the full length of the valley from the Lake Tiberias in the north to the Dead Sea in the south (Figure 2) and up to an elevation of 447m. The Jordan Depression running from Wadi Araba to the Dead Sea is a very distinctive landscape; it is the lowest depression on earth (with the Dead Sea at 419 m below sea level) and includes the Jordan River, flowing through the JV, which is considered the food basket of the region.

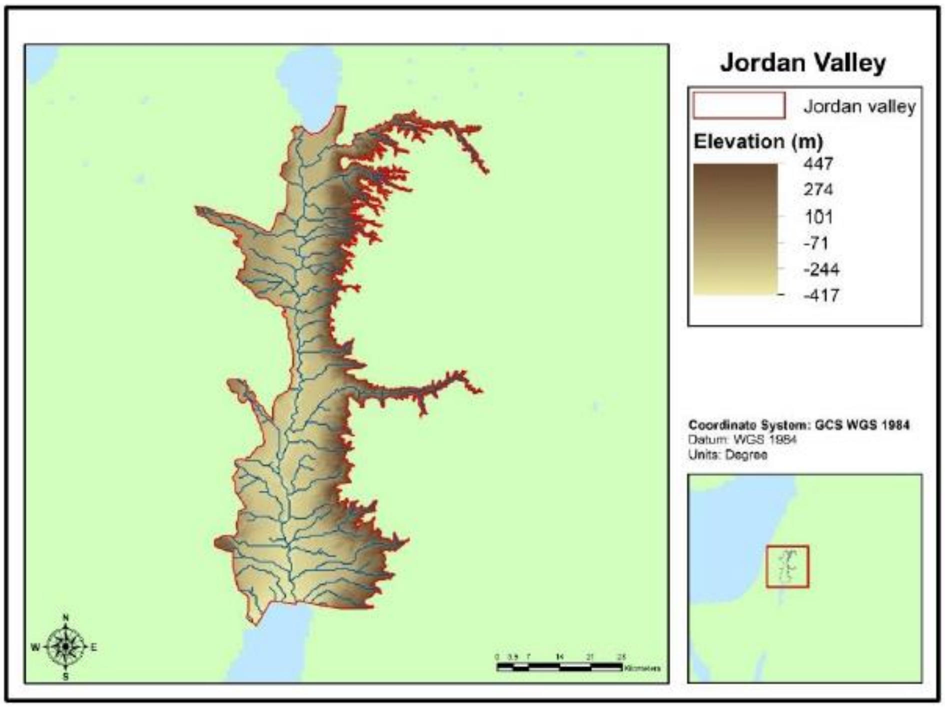

Figure 2. Topographic map of the study area: The Jordan Valley

The JV represents the main agricultural productive area for Jordan. It is about 104 km long; its width varies from 4 to 16 km between the Jordan River and the East Mountains chain. Based on the high variability of the physical and chemical natures of the soils along the JV, the areas were classified separately into (1) The Northern Ghor that lies below the Yarmouk River through the village of North Shounah and Addasiya to the village of Kreymeh; (2) The Middle Ghor that lies between the villages of Kreymeh and Karameh near Al-Maghtas; and (3) The Southern Ghor that lies between the village of southern Karameh to Al-Maghtas to Dead Sea.

The JV has a semi-arid hot climate: the average temperature is ranged between 15° and 22° from November to March and between 30° and 33° in summer; rainfall is very irregular: from 180 mm/year in the south, it can reach to 400 mm/year in the north of the valley. Based on water resources availability and quality, the JV's agriculture suitability varies significantly from Northern to Southern JV, therefore, each of the three parts of the JV has distinct agricultural patterns.

The Eastern part (in Jordan) of the JV spans an area of 1,343 square kilometers. The region's current population stands at 260,000, but this figure is projected to rise significantly to 403,699 in the long term. At present, the area is not covered by the wastewater treatment network, however there are future projects to cover JV with a wastewater network by 2030.

The West JV region has a total area of 1574 Km2. The Israeli part of the JV has a population of 60,000 that it is expected to increase to 72,000 in the short term and to 133,000 on the long term. Most of the villages are “Kibbutzim”, a communal living type that is unique to Israel, where all people belonging to the community share their properties and their enterprises. The Israeli part of the JV in the north is 693 Km2.

The JV in the West Bank represents 28% of the total West Bank Area. According to the Palestinian Central Bureau of Statistics (2017 Census), 56,908 people live in the Palestinian JV mostly in the Jericho area. The total area of the Palestinian part of the study area is 881 km2 with a population of around 70,000 habitants.

In the Palestinian JV, there are 39 settlements, the majority of which are agricultural, established on 12000 dunums. An additional 60000 dunums are inhabited by approximately 11,000 settlers. The number of Palestinian communities in the JV area is 27 located in an area of 10,000 dunums, and dozens of herding and Bedouin communities. The area of arable land in the JV is 280000 dunums (38.8% of the total area of the JV), of which the Palestinians exploit 50000 dunums while the settlers exploit 27000 dunums of its agricultural lands (Deliverable 5.1).

3. Results

The concept behind the methodology was to provide the stakeholders in each territory with the necessary data for establishing a reliable baseline information to base their opinion and have a conducive discussion on the challenges facing their territory. Figure 3 presents the components of the implementation followed in the gap analysis for the Jordan Valley. Stakeholder meetings were conducted in the three territories as part of the National Living Labs to identify the WEFE challenges, the leverage points and prioritize them. We used the methodology of the Causal Loop Diagrams (CLD) to illustrate and discuss with the stakeholders the complexity and the interdependence of the WEFE sectors and the interlinking of the main challenges. Then, in a Transnational Lab setting, the capacity of each community to address these challenges was assessed through the Community Capacity Assessment (CCA) methodology and the main barriers

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that need to be overcome to address them were identified. Once this was completed, the gap was assessed by identifying a series of key performance indicators (KPIs) and estimating the gap between the current state and the objective.

These stakeholder engagement assessments have been supported by a series of studies that aimed at mapping the WEFE Nexus (Governance, socio-ecological and WEFE resources) blended with quantitative/mathematical modelling of the hydrologic system, water allocation and energy. These studies provided the quantitative and qualitative data for the assessment of the gap in each territory. Once the gap was identified, the determinants that affect each challenge was determined, as well as a series of WEFE alternatives that may be considered in resolving the gap.

A detailed description of the results obtained from each component of the methodology follows, by presenting first the results of the WEFE nexus mapping and the modelling, then the results of the CLD and CCA stakeholder engagement, and finally the outcomes of the gap analysis.

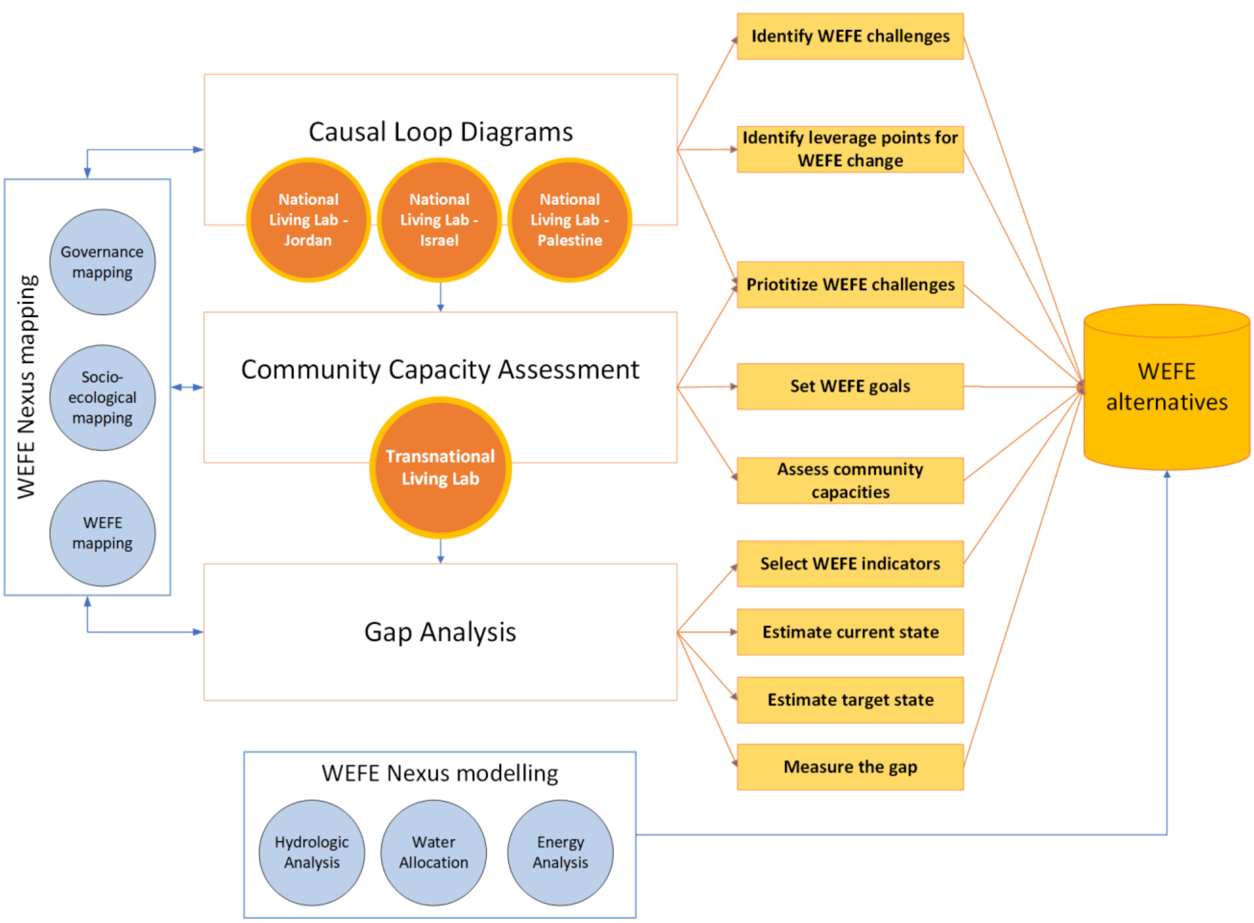

Figure 3. Implementation of the gap analysis methodology for the EcoFuture project

3.1 WEFE nexus mapping

3.1.1 Mapping of governance structures and stakeholder analysis

WEFE governance in the JV transcends political boundaries, involving a complex interplay of stakeholders' activities, policies, and conservation efforts. This approach recognizes that ecosystems are not confined by administrative borders and that their health and sustainability are crucial for local communities and the global environment. Effective WEFE management requires a collaborative, cross-sectoral, and interdisciplinary approach.

In Jordan, data collection has focused on water resource management, agricultural practices, and energy consumption patterns, with significant contributions from national agencies such as the Ministry of Agriculture, Ministry of Water and Irrigation and the Jordan Valley Authority. Israel's data collection leverages advanced technologies and robust agricultural practices, emphasizing water conservation, renewable energy integration, and sustainable food production. The data collection process in Palestine is more challenging due to geopolitical constraints; however, organizations like the National Agricultural Research Center (NARC) and various NGOs are actively involved in gathering information on water scarcity, land use, and agricultural productivity.

In total, there are 33 stakeholders in the water sector, 29 stakeholders in the Energy sector, 22 stakeholders in the Food sector and 11 stakeholders in the Ecosystem sector. In order to manage the WEFE nexus, 95 stakeholders have to be involved in the JV. The multitude and variety of the entities that are involved in the management of each sector, and the division of responsibilities that are not clear, make the governance of WEFE in the JV an extremely complicated procedure. The fact that the political level is excessively involved in the day-to-day management of each sector resulted in the weaknesses of the WEFE nexus and the corresponding challenges.

While the three countries share the same environment, the current governance structures and their supporting regulations are not aligned. An optimal socio-economic WEFE-resources management can be achieved only if the future policies are agreed between Jordan, Israel and Palestine.

3.1.2 Socio-ecological mapping

Through an overview and analysis of the current socio-ecological dynamics within the Jordan Valley, the goal of this process was to provide a holistic understanding of the valley, highlighting the intricate interplay between environmental health and human activities. Spanning territories in Jordan, Israel, and Palestine, crucial data about the region, including land use, water resources, ecosystems, pollution sources, and infrastructure accessibility, were gathered. Special attention was given to specific land utilization practices, particularly agriculture and urban expansion, alongside addressing pressing issues like water demand across residential, agricultural, and

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industrial domains. Furthermore, the potential implications of climate change and other significant challenges confronting the region were examined.

In Jordan, data collection has focused on the impacts of water scarcity on agriculture and food security, as well as the socio-economic pressures from unemployment, population growth, and the influx of refugees. On the other hands, Israel's data collection has emphasized the advanced technological integration in agriculture, energy, and water management, alongside the social disparities that exist between different communities. For Palestine, data collection has been complicated by political constraints, with a focus on the economic impacts of restricted movement and access to resources, high unemployment rates, and the reliance on international aid. Across all three territories, the socio-economic data collection has been crucial for understanding how economic activities, social structures, and resource management practices interact within the WEFE Nexus, shaping the resilience and sustainability of each region's development.

The socio-ecological mapping revealed distinct discrepancies between the three territories in terms of population growth, economic status and unemployment as well access to resources and opportunities to development. Despite the very different socio-economic and political circumstances between Palestinians, Israelis and Jordanians, they all face a number of common challenges such as land degradation, water scarcity and quality decline which have been extenuated by climate change. The resulting decrease in precipitation, increased urbanization/population, as well as competition between agricultural lands and natural landscapes are causes of environmental degradation and stress on water, energy and biodiversity resources.

Overall, the land use distribution in the JV comprises of 61.5% of natural/uncultivated land, 32.9% agricultural land and aquaculture and the remaining to be urban areas, wadis and reservoirs. Pollution sources in the JV include untreated wastewater, solid waste disposal, impacts from agriculture and aquaculture as well as land mines remnants of historical conflicts. Pollution sources and geogenic origin salinity have deteriorated the water quality of Jordan River and over-exploitation has decreased dramatically its flow. The surface water network of the JV is in urgent need for ecological restoration.

Even though the socio-ecological landscape presents significant challenges, ecological actions that would address preservation of biodiversity, sustainable water management, rehabilitation of degraded landscapes, sustainable agriculture, development of renewable energy and ecotourism and nature-based recreation, would guide the region towards socio-ecological sustainability (Deliverable 2.1).

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3.1.3 Mapping of WEFE resources

The objective of this process was to map all WEFE resources in three periods: (1) The current situation, (2) existing plans for the coming years, and (3) the prospected needs of WEFE resources in 30-50 years. The supply and demand of each component of the WEFE nexus was estimated in terms of geographical distribution, water quality, and quota of water devoted per land designation for agriculture, industries, other usage, and environmental services available.

In Jordan, extensive stakeholder engagement was conducted through interviews and focus group discussions with local stakeholders, including farmers, business owners, community leaders, academia and policymakers. This was complemented by utilizing government reports and datasets from departments such as the Ministry of Water and Irrigation, Ministry of Agriculture, and Ministry of Energy and Mineral Resources. Data from international agencies like the FAO, World Bank, and various NGOs were also incorporated. Remote sensing and satellite imagery provided up-to-date information on water bodies, land use, and vegetation cover, while surveys and structured interviews with local residents, farmers, and business owners offered specific insights into the current state of the WEFE nexus. In Israel, data collection included advanced stakeholder workshops, interviews with policy makers, farmers, and experts, and the use of remote sensing technologies. Governmental and institutional reports were reviewed, particularly from the Ministry of Agriculture, Ministry of Economy, and environmental agencies. In Palestine, the data collection process was characterized by significant engagement with local communities, involving interviews, focus group discussions, and surveys with farmers, policy makers, and community leaders. Reports from local NGOs, international organizations, and government bodies were utilized to understand the severe water scarcity issues and energy constraints. Remote sensing and satellite imagery also played a crucial role in providing detailed information on land and water use.

Based on the WEFE nexus mapping conducted for the JV, the following issues have been identified as of the highest priority to address:

- **Water deficit** – The agricultural water uses accounts for 91% of the total water supply where 16% is used for aquaculture and 75% for irrigation. The irrigation rates range from 385 mm/dunum for Israel to 622 mm/dunum for Jordan and 360 mm/dunum for Palestine. The differences in irrigation rates are due to water losses/leakages in the network that is estimated to be about 30% for Jordan and 50% for Palestine. If we account for water losses in the distribution network in Jordan and Palestine, only half of this water is reaching the consumers. Reuse of treated wastewater is also very low in Palestine. On the other hand, the demand for both drinking and agricultural water use is quite significant in Jordan and especially in Palestine (where only a small fraction of the agricultural land is irrigated) creating a significant deficit between supply and demand.

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- **Water quality** – The available water supply in the JV has been impacted by high water salinity levels due to geogenic causes. In addition, the main sources of anthropogenic pollution in the JV are wastewater from treatment plants and unsewered areas, fertilizer, pesticide and herbicide pollution from agriculture, urban solid waste disposal sites, aquaculture water use, and small "industrial" facilities mostly related to agriculture have impacted the water quality of Jordan River and create an additional stress on the ecosystem.
- **Energy mapping** – Energy supply appears to meet current demand; however, energy demand increases are expected to be high, necessitating in this way the development of an integrated strategy for the JV that should be based on renewable energy. Renewable energy supply from the JV has a huge potential, far higher than the expected JV demand, even in year 2050.
- **Soil degradation** – The agricultural land has been degraded due to continuous cultivation for millennia which has as a result extremely low soil organic carbon. The impact of this situation is depicted in the estimated production yields for the JV. This is a common problem for the three territories of the JV necessitating measures for soil restoration using agro-ecological practices and active carbon additions to soils that will improve soil quality, fertility and health.
- **Ecosystem degradation** – The environmental pressures exerted in the JV are the result of intensive agricultural activities (agriculture, livestock and aquaculture), tourism, climate change, geogenic pollution, population and migration and invasive species. These pressures have resulted in significant impacts to the WEFE Nexus with surface water flow decline, groundwater depletion, high groundwater salinity, pollution and loss of biodiversity. To ensure the long-term sustainability of the region's ecosystems, integrated and sustainable management approaches are essential to mitigate these impacts.
- The impact of climate change was also identified as an important issue in JV, since precipitation in the North Ghor station was reduced from 395 mm in 1982 to 351 mm in 2021 (11% reduction) and in Mid Ghor from 338 mm in 1982 to 224 mm in 2021 (34% reduction) while the average temperature has increased by 1.9 ^{o}C in both stations during the same period.

3.2 WEFE Nexus modelling

Three quantitative modelling studies have been conducted to assess the hydrologic balance, the water distribution and the energy demand in the three territories. These studies are the precursors of the follow up studies to be conducted in the second phase of the project, which will be the ecosystem and climate change assessment (continuation of the hydrologic study), modelling of the agricultural economy of the region (coupled with the water allocation model)

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and the scenarios of the energy distribution system to cover future demand. The results of alternative scenarios from these models will provide the stakeholders the information for the co-design of WEFE alternatives that will be included in the Strategic Plan to combat desertification.

Hydrologic modelling: The aim of the hydrologic calibration was to capture the annual average flow of the Jordan River before it enters the Dead Sea and establish an average hydrologic budget for the JV. The hydrologic system of the Jordan valley is heavily modified with many reservoirs, canals and pumping stations that divert water for irrigation and drinking water supply. Heavily modified hydrologic systems require detailed daily time series of flow data for the inflow and outflow from the reservoirs, as well as water abstractions and diversions which are not available for the Jordan Valley basin. The lack of available data, as well as the presence of a complex and insufficiently documented management system for water availability and distribution in the study area, coupled with conflicting information regarding available water supplies and extractions, currently renders precise and detailed modeling of the area unattainable. The collection of the data in all three territories became extremely difficult due to the ongoing war in Gaza.

Based on the hydrologic simulation for the years 2000-2021, the following hydrologic budget for the Jordan Valley was estimated. The total area simulated is 3938 km^2, the annual average areal weighted precipitation was 290 mm and the annual average areal weighted ET 183 mm. This translates into 1142 MCM/year of precipitation volume and 719 MCM/year volume of ET. The available water is the difference 423 MCM/year of which 104 MCM/year is the average outflow of Jordan River to the Dead Sea. In addition, the groundwater abstraction has been estimated to 146 MCM/year in the three territories (not accounting for the pumping in Area C of the Palestinian territory). The available water resources in the JV are extremely limited and are expected to decline due to climate change with significant impact on the ecosystem and the biodiversity as well as the available water supply to cover the demand for drinking water and agriculture.

Water allocation modelling: To evaluate the available water resources in the JV the hydrologic model Karst-SWAT was used. The Karst-SWAT is a watershed-based model that accounts for the spatial variability of the watershed by subdividing it into sub-catchments. Within each sub-catchment it specifies what is referred to as Hydrologic Response Units (HRUs). Each HRU is a combination of land use, soil and slope and is defined vertically from the vegetation to shallow and deep aquifers. Historical, precipitation, meteorological and hydrologic flow data have been used to calibrate the model for the JV. Once the model has been calibrated, the available water in every sub-basin could be estimated, as well as future climate change scenarios could be simulated in order to assess the impact of climate change on water availability.

Characterization of the JV regional water sources (aquifers, wastewater treatment plants) and uses (urban, agricultural crops) by water quality classification (freshwater, treated wastewater, brackish water) and quantities, and the connectivity across suppliers and consumers within the region and between the JV and adjacent regions in Israel, Jordan and Palestine. Based on this information, the MYWAS-VALUE model has been calibrated and applied to simulate various scenarios and assess their implications on the water and agricultural economies of the JV, i.e. to assess how changes in the water supply and demand in the JV affect the optimal development of infrastructures, while accounting for the distribution of water scarcity across regions and time.

Energy analysis: The three territories hold the same strategy and face the same obstacles on the way to accomplishing their national energy plans. Most of the land in the JV is rural, the primary energy consumer is the residential sector and the second is the water sector which is the main resource for agriculture. The current situation is that, in the JV, the three territories can provide satisfactory energy supply and demand services by mainly non-renewable sources. Currently the electricity in the region is primarily served by national grids, with notable variations in standards and infrastructure among the three countries. Natural gas is a significant energy source, with renewable sources like solar and biofuels being explored for future needs. Water-intensive activities like agriculture and desalination significantly impact energy consumption.

Substantial population increases are projected by 2050, driving up energy demand, particularly for residential, industrial, and commercial sectors. There is a strong push towards renewable energy sources, with ambitious national targets (Israel: 30% by 2030, 80% by 2050; Jordan: various targets). The JV is expected to contribute significantly through solar and biofuel energy. It is important to notice that the renewable energy supply potential from the JV is 4 to 10 times higher compared to the total estimated energy demand in the JV, even in year 2050. The main resource is the solar energy but biogas and biofuels from waste can compensate the dispatchable energy demand needed to overcome seasonal solar energy fluctuations. Particularly, supporting local small-scale renewable energy production can provide additional income to the region by selling it to the national grids and assisting the nations to hold to their RE targets. Decentralized renewable energy microgrids will also contribute to regional energy sufficiency and energy democratization.

However, the future ability of the national grids to absorb significantly more electricity from renewable sources cannot be trusted. Selling and buying energy from the national providers may be economically justified, but such agreements may be at odds with the quest for maximal energy security. Therefore, self-usage of the energy produced by consumers behind the grid, is advocated. Total off-grid installation is less favorable since the grid connection provides flexibility and better security of supply. Curtailment and economical LCoE can be achieved by encouraging energy non-regrate-solutions such as advance agricultural usage, development of local energy intensive industries, thermal and electricity storages, etc. Additionally, energy demand for water-related activities (pumping, treatment) is expected to remain high, with a significant portion anticipated to be met by renewable sources.

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In the longterm, the JV is envisioned as a region with substantial renewable energy integration, supported by robust microgrid systems, and capable of meeting its energy needs predominantly through local resources. This vision includes fostering regional cooperation and developing infrastructure "rings" (electricity, gas, water, wastewater, communication) to facilitate efficient resource management and peer-to-peer trade. Such a scenario is currently extremely problematic due to the ongoing war and the century-old political conflict between the nations. Since we wish to recommend practical solutions, we ought to be sensitive to the political gaps. This scenario and others will be examined as part of the development of the Strategic Plan for the area in the second phase of EcoFuture.

Overall, the energy analysis has identified significant knowledge gaps regarding the structure of the system as well as incomplete and inconsistent data across the three countries that hamper accurate energy planning and forecasting. Current grids and substations may not support the expected increase in renewable energy generation and overall energy demand without significant upgrades. This energy analysis highlights the critical need for coordinated efforts to upgrade infrastructure, integrate renewable energy sources, and address data gaps to ensure a sustainable and secure energy future for the Jordan Valley.

3.3 Shaping a common understanding of the nexus structure with Causal Loop Diagrams

The Causal Loop Diagram analysis (Figure 4) has been used as the first step of stakeholder engagement within the project and as a first attempt for the identification of priorities in the JV. A 3-prong approach was used to develop and analyze the CLD for the JV. The process was to first create a draft CLD for the JV based on literature review and expert knowledge, and then validate it in collaboration with the EcoFuture partners. We asked the partners to confirm the draft nexus challenges, add missing challenges and rank the challenges in each area (Stage I). Once their feedback was received, the revised CLD can accommodate all the changes and weights can be applied so the statistics reflect the priorities of the challenges ranked by the partners. The next step was to validate the CLD with key stakeholders involved in the National living labs and revise it according to stakeholder feedback if necessary and rank the challenges. Once this process was completed in the three territories, a unified CLD for the JV was created (Stage II). The third stage (Stage III) was to analyze the unified CLD and compare and contrast the prioritization of the challenges in each of the three territories. The final step was to present the unified CLD to the WEFE prioritization workshop. This methodology allowed to identify the priorities regarding the Nexus challenges of the three territories and conflicting actions within and between territories as well as achieving a common understanding of the challenges, problems and impacts to the WEFE Nexus for the JV.

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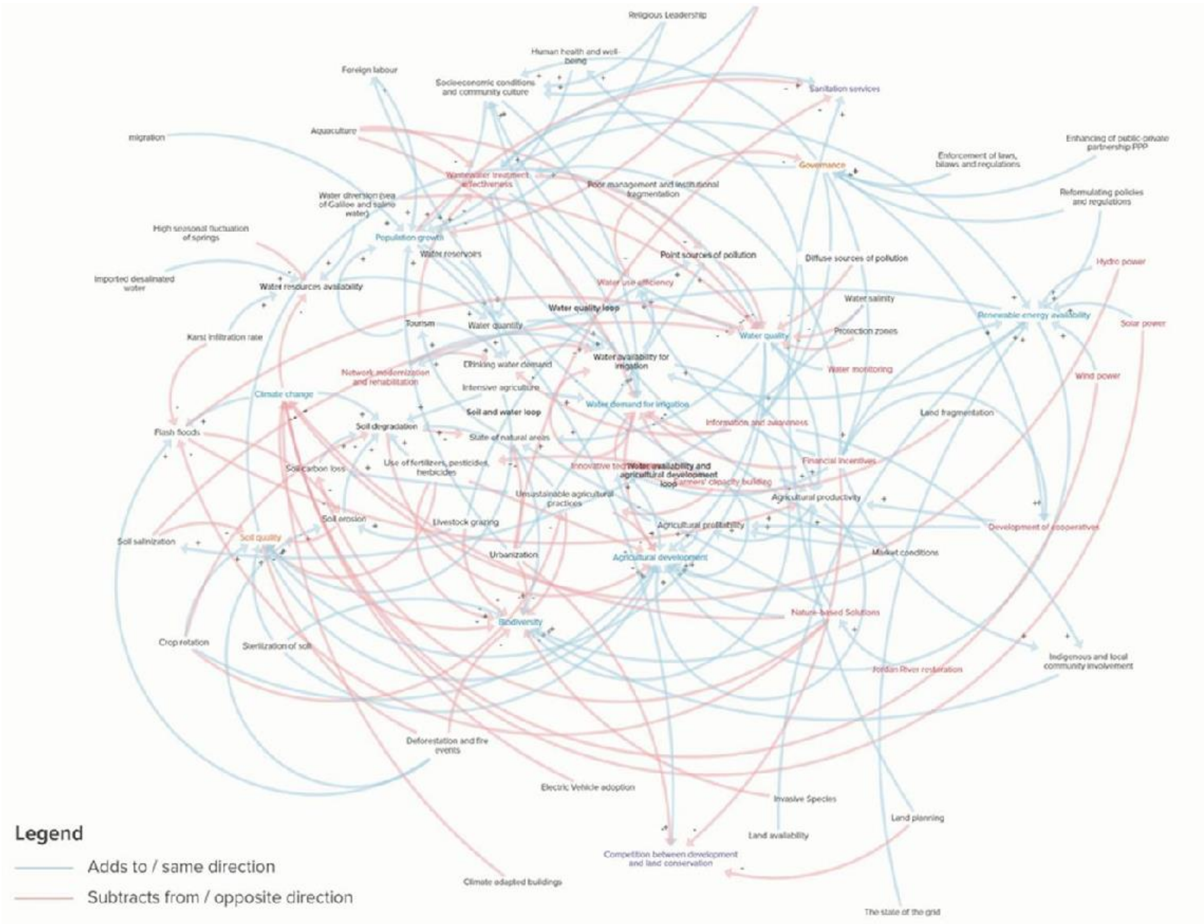

Figure 4. Conceptualization and mapping of the unified CLD for the Jordan Valley

Through this analysis, the challenges that face JV were identified and prioritized. Ensure water demand for irrigation, water quality, agricultural development, renewable energy availability, biodiversity loss, climate change (adaptation or mitigation), population growth, was the initial list of identified challenges in the area according to the scientific experts. The Jordanian partners added two more challenges in the initial list of challenges: soil quality and governance, while Israeli partners added competition between development and land conservation and sanitation services (wastewater & solid waste).

The ranking of the challenges of the Jordanian stakeholders was the same as identified by the EcoFuture Jordanian partners indicating the importance of close collaboration between the National Agricultural Research Center and the JV stakeholders in understanding stakeholder needs and priorities.

There are similarities and differences in priorities for the three territories according to the Israeli, Jordanian, Palestinian stakeholders (Table 1). The top four challenges according to the Jordanian and Palestinian stakeholders are mainly related to agriculture: water quality, water demand for

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irrigation, and agricultural development. Soil quality is included in the list of the top challenges from Jordanian perspective, while renewable energy availability is included in the list from Palestinian perspective. On the other hand, for Israeli stakeholders, climate change, competition between development and land conservation, biodiversity and renewable energy availability are of high priority. The next (lesser) priorities for Jordanian and Palestinian stakeholders are biodiversity and climate change. Jordanian stakeholders included among the list of challenges of lesser priorities the renewable energy availability and governance. For Israeli stakeholders, population growth, sanitation services, agricultural development and water quality constitute the next (lesser) priorities. The last priority for Jordanian and Palestinian stakeholders is population growth while for Israeli stakeholders is water demand for irrigation (Table 1). From the results of the prioritization of challenges, it is concluded that the priorities for Palestinian and Jordanian stakeholders are similar while Israeli stakeholders have other priorities.

Table 1. Stakeholder prioritization of challenges facing in the JV

	Jordan	Israel	Palestine
Highest priorities	1) Water quality 2) Water demand for irrigation 3) Soil quality 4) Agricultural development	1) Climate change 2) Competition between development and land conservation 3) Biodiversity 4) Renewable energy availability	1) Water demand for irrigation 2) Water quality 3) Agricultural development 4) Renewable energy availability
Lesser priorities	5) Biodiversity 6) Climate change 7) Renewable energy availability 8) Governance	1) Population growth and Sanitation services 2) Agricultural development 3) Water quality	1) Climate change 2) Biodiversity
Last priority	9) Population growth	4) Water demand for irrigation	1) Population growth

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3.4 Appraising community priorities and capacities with Community Capacity Assessment

Based on the mapping of the WEFE resources (supply and demand), the CLD developed for the JV, and the hydrologic analysis, water allocation and energy analysis of the region, two workshops (one Jordanian and Palestinian joint workshop and one Israeli workshop) were conducted with the stakeholders to identify the priorities for each country and for the JV as a whole. The initial idea was to conduct a transnational living lab between the three territories. However, the geopolitical situation and the war in Gaza affected mainly the transnational living labs. Given the situation, the timing of the transnational living lab had to be postponed, as well as instead of one workshop, two workshops had to be conducted, one Jordanian and Palestinian joint workshop and one Israeli workshop. This decision was strengthened by the fact that according to the CLD analysis, the Jordanian and Palestinian stakeholders had set similar highest priorities, while Israeli stakeholders set different priorities.

In the workshops, a CCA methodology also known as Capacity Factor Analysis (CFA), was followed (Ahmad 2004; Bouabid 2004), where the stakeholders ranked the challenges, issues and problems, and thus set priorities to the problems that need to be addressed in the region. The results of the workshops were used as feedback for the gap analysis.

Through the CFA, the workshops assessed the capacity of the stakeholders to address their highest priority challenges by identifying the problems and barriers to fulfil the priorities. In particular, the following four challenges were assessed in the Jordanian/Palestinian workshop: water quality, water demand for irrigation, soil quality and agricultural development. The challenge ‘Renewable energy availability’ was assessed as part of the energy capacity horizontally. Similarly, the Israeli workshop addressed the following four challenges: ‘Climate change’, ‘Competition between development and land conservation’, ‘Biodiversity’, ‘Renewable energy availability’.

Through this methodology, the institutional, human resources, technical, economic and financial, and energy capacity for each of the identified challenges were assessed. The status of each capacity was described by assessing a set of requirements with the help of specific questions (Supplementary Information) developed for this purpose. The set of questions may be designed to measure each of these requirements, while the list of requirements may be edited and updated based on the collected data regarding the current situation. Table 2 presents the requirements used in this study to measure the five capacity factors. By quantifying these capacities, the status of the community can be better described, leading to a better understanding of the type of intervention needed and the community capacities that will need to get more attention.

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Table 2. Requirements used in this study to measure the five capacity factors.

Capacity factors	Requirements
Human capacity relates to the labor that is available to provide the services and its level of training.	- Educational level - The level of knowledge of their own system - Received training on the technology and involvement in operating the system - Ability to perform the required operation and maintenance - The understanding and acceptance of the use of treated greywater in irrigation
Technical capacity relates to the logistics necessary to address the components of technology that are needed for the implementation of solutions.	- Operations, maintenance, upgrading or adaptation, and supplies. - Understanding of the technology - Understanding the restrictions in treated water use - Ability to operate the system - Ability to maintain the system - Current status of the system
Institutional capacity defines the components of the institutional framework that needs to be in place to provide the services.	- Associated regulation - CSO support and follow-up - Existing structure - Water supply (quality and quantity)
Financial and economic capacity represents the financing of the services, the availability of loans, and the financial assets in the community.	- Income generating activities - Income/expenditure ratio - Expenditures priorities - Water and sanitation costs - Willingness to pay (system cost, O&M)
Energy capacity deals with the available energy, its availability, its costs, and reliability.	- Primary sources - Back-up sources - Percentage of budget - Rate of outage

The assessment of various capacities among farmers in Jordan and Palestine highlighted several key findings and areas for improvement:

- Human Resources: Participants had diverse educational backgrounds, with limited agricultural specialization. Training primarily focused on basic aspects of water quality and irrigation, with a lack of comprehensive understanding in soil quality and cooperative

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functions. Improvement is needed in specialized training and awareness of agricultural cooperatives.

- Technical Capacity: There was a reactive approach to maintenance and limited use of advanced technologies. While basic irrigation technologies were accessible, the use of laboratory analyses for water quality was rare. Enhanced technical training and access to advanced tools are recommended.
- Institutional capacity: Participants had limited knowledge of regulations and standards for water and soil management. Key institutions were recognized, but there was a lack of understanding regarding the legal framework governing agricultural cooperatives. Increasing awareness and knowledge of relevant laws and regulations is crucial.
- Financial constraints were a significant barrier to adopting new technologies and improving agricultural practices. Costs for water and energy were burdensome, with participants generally dissatisfied with financial returns. Financial support and cost-effective solutions are needed to alleviate these issues.
- Energy Capacity: Reliance on grid electricity was predominant, with minimal use of renewable energy sources. Energy costs impacted income, highlighting the need for affordable and sustainable energy options.

On the other hand, the key findings from the Israeli living lab workshop were as follows.

The participants displayed a foundational understanding of climate change issues, particularly concerning water accessibility and extreme weather events. They highlighted the necessity of intergenerational information exchange for effective adaptation, yet revealed gaps in their preparedness and knowledge, especially regarding Nature-Based Solutions (NBS) and dual land use. While they possessed good technical knowledge of relevant technologies, financial constraints and hesitations about practical experience remain significant barriers. Additionally, the participants demonstrated a comprehensive awareness of the roles and regulations of key institutions involved in climate adaptation, despite lacking detailed insights into transboundary issues. Lastly, financial concerns, particularly the rising cost of water, emerged as a critical economic challenge for their businesses. Overall, these findings underscore the need for improved education, financial support, and institutional collaboration to enhance the community's capacity to adapt to climate change.

Overall, there is a noticeable disparity in the levels of various capacities among the participants from different jurisdictions. Jordanians and Palestinians face challenges due to a limited educational background, limited access to proper training and capacity-building activities, a limited understanding of regulations and standards and additionally, they lack access to new technologies. In contrast, Israelis benefit from a more established environment, where the

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primary challenge is financial rather than access to training and expertise. They also possess a deeper understanding of regulations and better community organization.

To address these challenges, it is crucial to design interventions that not only address the identified priorities but also consider these existing differences. A comprehensive approach should include targeted training programs, improved access to modern technologies, and enhanced understanding of regulatory frameworks. Financial assistance and the promotion of renewable energy sources are also essential. These measures will help develop a resilient and sustainable agricultural sector in the region.

3.5 Paving the way for the selection of WEFE alternatives with Gap Analysis

The gap analysis is the final step of the framework presented in this paper, which leads to the design of WEFE solutions and links the outcomes of the first phase with the second phase of the project. For implementing the gap analysis in the EcoFuture project, we have focused on the challenges that have been highly prioritized by the stakeholders in the three countries during the living labs. These WEFE challenges have been expressed as goals, and subsequently a set of KPIs has been selected to monitor the current and target states regarding the achievement of these goals. The selection was performed by the consortium by reviewing both the Sustainable Development Goals (SDG) indicators and the indicators developed by the European Commission to assess NBS (European Commission et al., 2021b), while at the same time considering their appropriateness to the identified goals and their applicability in the case of the JV.

Subsequently, the current and target state of the indicators was identified based on the mapping of the region (Deliverable 1.1 and Deliverable 2.1), and where necessary complemented with more inputs from the partners. For each of these indicators, the gap is represented by the difference between the target and the current state. The highly prioritized WEFE nexus goals, their indicators and the measured gaps are presented in Table 3.

Subsequently, for each goal, the drivers of the measured gaps were identified and correlated with potential solutions to bridge those gaps and achieve target states. Different types of interventions, addressing different gap determinants, e.g. knowledge, infrastructure, practices, politics, were identified. Table 4 presents the identified determinants and solutions for the analyzed WEFE goals. This identified set of solutions represents a first version of the program of measures that will be further analyzed and assessed in the next phase of the project, to finally provide strategic insights for the region.

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Table 3: Highly prioritized goals, their indicators and measured gaps in each country

WEFE Nexus Goals	Indicators	Target state	Current state	Gap	Source
Jordan					
Ensure water quality	Proportion of wastewater safely treated (%)	95	89	6	Tawfiq et al., 2023
	Effectiveness of wastewater treatment (BOD load reduction) (%)	95	80	15	NWMP-3, 2023
	Proportion of saline groundwater desalinated (%)	45	10	35	Qteishat et al., 2024
	Effectiveness of desalination (%)	90	82	8	Expert discussions
	Effectiveness of aquaculture water treatment (%)	50	0	50	NWMP-3, 2023
Meet water demand for irrigation	Quantity of water supply (MCM/yr)	426	230	196	NWMP-3, 2023
	Irrigation losses from infrastructure (%)	15	30	15	National Water Strategy, 2023
	Proportion of TWW that is reused for irrigation (%)	70	42	28	MWI, 2023
	Use of alternative water supplies from on farm water harvesting (%)	10	3	7	Experts discussions
	Use of desalinated water (%)	10	5	5	Experts discussions
	Degree of integrated water resources management implementation (%)	80	64	16	Status report (IWRM), 2021
Ensure soil quality	Proportion of degraded agricultural land (low carbon & salinisation) (%)	40	70	30	Ammari, et al., 2013
	Proportion of farms with active carbon addition (%)	50	25	25	Expert discussions
	Proportion of farms using agroecological practices (%)	5	1	4	
	Productivity yield gap (%)	10	20	10	DoS, 2023
Ensure agricultural development	Average annual income of small-scale food producers (USD)	5000	1500	3500	Sergaki et al., 2020
	Total official flows to the agricultural sector (5-point Likert scale)	4-good	2-poor	2	Rabboh, et al., 2023
	Proportion of farmers participating in cooperative agricultural schemes (%)	30	10	20	ARDI, 2022
	Farmer capacity building actions (5-point Likert scale)	4-good	2-poor	2	Rabboh, et al., 2023
Palestine					
Ensure water quality	Proportion of wastewater safely treated (%)	90	43	47	Expert discussions
	Effectiveness of wastewater treatment (%)	90	70	20	Expert discussions
	Proportion of saline groundwater desalinated (%)	90	10	80	Expert discussions
	Effectiveness of desalination (%)	90	50	40	Expert discussions

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	Effectiveness of aquaculture water treatment (%)	50	0	50	Expert discussions
Ensure water availability for irrigation	Quantity of water supply (MCM/yr)	182	52	130	Expert discussions
	Irrigation losses from infrastructure (%)	15	40	25	Expert discussions
	Proportion of TWW that is reused for irrigation (%)	30	2	28	Expert discussions
	Use of alternative water supplies from on farm water harvesting (%)	10	2	8	Expert discussions
	Use of desalinated water (%)	5	1	4	Expert discussions
	Degree of integrated water resources management implementation (%)	80	20	60	Expert discussions
Ensure agricultural development	Average annual income of small-scale food producers (USD)	8880	4440	4440	Expert discussions
	Total official flows to the agricultural sector (5-point Likert scale)	4-good	2-poor	2	Expert discussions
	Proportion of farmers participating in cooperative agricultural schemes (%)	50	10	40	Expert discussions
	Farmers capacity building actions (5-point Likert scale)	4-good	2-poor	2	Expert discussions
Ensure renewable energy availability	Renewable energy share in total final energy consumption (%)	33	2	31	Expert discussions
	Proportion of renewable energy over total energy used in agriculture (%)	20	0.2	19.8	Expert discussions
	Electrical grid modernization status (5-point Likert scale)	4-good	2-poor	2	Expert discussions
Israel					
Ensure renewable energy availability	Renewable energy share in total final energy consumption (achievable target - 2030 National Plan) (%).	30	7	23	National Plan, 2020
	Renewable energy share in total final energy consumption (ambitious target - energy experts) (%).	90	7	83	Expert discussions
	Proportion of renewable energy over total energy used in agriculture (achievable target - 2030 National Plan) (%)	30	10	20	Expert discussions
	Proportion of renewable energy over total energy used in agriculture (ambitious target – energy experts) (%)	90	10	80	Expert discussions
	Electrical grid modernization status (5-point Likert scale)	4-Good	4-Good	0	Expert discussions
Climate change adaptation and mitigation	Existing policy for climate change (5-point Likert scale)	4-Good	2-Poor	2	Expert discussions
	Local capacity building actions for climate change adaptation and mitigation (5-point Likert scale)	4-Good	4-Good	0	Expert discussions
	National capacity building actions for climate change adaptation and mitigation (5-point Likert scale)	4-Good	2-Poor	2	Expert discussions
	Actions for carbon removal/ storage in vegetation or soil (5-point Likert scale)	4-Good	3-Acceptable	1	Expert discussions

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Development stresses mitigation	*Local* regulations for land planning and land conservation (5-point Likert scale)	4-Good	3-Acceptable	1	Expert discussions
	National regulations for land planning and land conservation (5-point Likert scale)	4-Good	2-Poor	2	Expert discussions
	Proportion of natural and protected areas (%)	65.8	65.8	0	Grossbard and Renan, 2024
Biodiversity loss mitigation	Biodiversity conservation regulations and actions (5-point Likert scale)	4-Good	3-Acceptable	1	Expert discussions
	Protection of native species - INPA (5-point Likert scale)	4-Good	4-Good	2	Expert discussions
	National legislation for the control of invasive alien species – INPA (5-point Likert scale)	4-Good	2-Poor	2	Expert discussions

Table 4: The identified drivers and solutions for the analysed WEFE nexus goals

WEFE Nexus Goals	Drivers	NBS and strategies
Ensure water quality	Aquaculture, Water diversion (sea of Galilee and saline water, Flash floods, Soil sanitization, Point sources of pollution, Diffuse sources of pollution, Water salinity, Protection zones	Socioeconomic conditions and community culture improvement, Protection and conservation strategies in terrestrial ecosystems, Promote reduced irrigation practices, Monitoring, Agricultural landscape management, Ecological restoration of degraded terrestrial ecosystems, Restoration and creation of semi-natural water bodies and hydrographic networks, Wastewater treated effluent improvement
Ensure water demand for irrigation	Losses – infrastructure, Limited available fresh water, Limited reuse of desalinated water, Poor management and institutional fragmentation, Socioeconomic conditions and community culture, Limited Wastewater treatment effectiveness, Intensive agriculture, Excess irrigation, Limited reuse of wastewater – quality, Water scarcity in certain regions – politics, Illegal use of water	Aquaculture, Farmers capacity training, Information and awareness, Financial incentives, Promote reduced irrigation practices, Monitoring, Agricultural landscape management ,Wastewater treated effluent improvement, repair the water network infrastructure
Ensure soil quality	Intensive agriculture, Unsustainable agricultural practices, Limited crop rotation, Sterilization of soil, Soil salinization, Soil erosion, Deforestation and fire	Protection and conservation strategies in terrestrial ecosystems, Promote reduced irrigation practices, Monitoring, Agricultural landscape management, Ecological restoration of degraded terrestrial ecosystems, Restoration and creation of semi-natural water bodies and hydrographic networks, Wastewater treated effluent improvement

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	events, Use of fertilizer, pesticides and herbicides, Water quality	
Ensure agricultural development	Soil degradation, Use of fertilizer, pesticides and herbicides, Unstable agricultural practices, Water demand for irrigation, Crops production resiliency, Post harvesting treatment	Innovative technologies adoption, Increase Farmers capacity building, Market conditions, Renewable energy (dual use), Crop selection, Precision agriculture, Climate adapted habitats, Food storage and processing, Promote reduced irrigation practices, Monitoring, Agricultural landscape management, Wastewater treated effluent improvement
Ensure renewable energy availability	Grid stability limitations (including connection capacity and storage)	Wastewater treatment effectiveness, Network modernization and rehabilitation, Water availability for irrigation, Financial incentives, Agricultural development, Land availability, The state of the grid, Reformulating policies and regulations, hydro, wind and solar power, Local smart-grid islands, non-regrate energy solutions, biogas and biofuels production, dual-use of agricultural lands.
Climate change (adaptation or mitigation)	Flash floods, soil degradation	Electric vehicle adoption, Climate adapted buildings, Wind, solar and hydro power, Protection and conservation strategies in terrestrial ecosystems, Promote reduced irrigation practices, Monitoring Agricultural landscape management, Ecological restoration of degraded terrestrial ecosystems, Restoration and creation of semi-natural water bodies and hydrographic networks, Wastewater treated effluent improvement, Climate change adaptation/mitigation regulations
Development stresses	Urbanization, Population growth	Land planning, Financial incentives, Regulations for land planning and land conservation
Biodiversity loss	Climate change, Deforestation and fire events, Use of fertilizers, pesticides, herbicides, Livestock grazing, Urbanization, Unstable agricultural practices, Invasive species	Information and awareness, Indigenous and local community involvement, Protection and conservation strategies in terrestrial ecosystems, Promote reduced irrigation practices, Monitoring, Agricultural landscape management, Ecological restoration of degraded terrestrial ecosystems, Restoration and creation of semi-natural water bodies and hydrographic networks, Wastewater treated effluent improvement, Biodiversity loss mitigation regulations

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4. Discussion

The gap analysis provides a detailed and quantitative overview of the WEFE challenges faced in the JV. It presents in a systematic manner the gaps in the 'WEFE performance' of the three territories, facilitating comparative assessment between the territories and among different goals.

For Jordan and Palestine, the highest priority goals are those related to water, i.e. to 'Meet water demand for irrigation' and to 'Ensure water quality'. The next priority for both Jordan and Palestine is to 'Ensure agricultural development'. 'Ensure soil quality' is also included in the list of the top goals from the Jordanian perspective, while 'Ensure renewable energy availability' is included in the list from the Palestinian perspective.

On the contrary, for Israel, the water-related issues have been given lower priority, therefore they are not systematically presented in the gap analysis. This does not mean that the gap for these goals would be smaller in Israel. In fact, Israel is in a better current state but has set more ambitious objectives regarding these goals. For example, Israel aims to raise the water supply for irrigation from 1200 MCM/year to 1950 MCM/year to meet the expected future demand. It also aims to raise its desalination capacity from 700 MCM to 1000 MCM, and the reuse of treated wastewater in agriculture from 484 MCM/year to 758 MCM/year. However, considering the adequate current state of these indicators, other more pressing issues have been given higher priority by the Israeli stakeholders. Specifically, 'Climate change adaptation and mitigation', 'Development stresses mitigation', 'Biodiversity loss mitigation' and 'Renewable energy availability' are those given the highest priority and, thus, included in the gap analysis.

The results of the gap analysis for the three countries are discussed below. For each of the aforementioned goals, the gaps of the respective countries that assign high priority to this goal, are comparatively presented.

Specifically,

- The **'water quality'** indicators assess the wastewater treatment, desalination and aquaculture water treatment performance in the territories. Jordan shows a relatively small gap in the proportion of treated wastewater but a considerable gap in wastewater treatment effectiveness, which needs to rise from 80% to 95% (15% gap) to meet the target. Desalination effectiveness presents a small gap but the proportion of desalinated water needs to rise from 10% to 45% (35% gap). Finally, a wide gap (50%) is recorded for aquaculture water treatment effectiveness, as treatment of aquaculture water is currently not practiced in Jordan. The situation for Palestine is even more challenging, with wide gaps across all water quality indicators. The proportion of treated wastewater needs to rise from 43% to 90% (52% gap), and the treatment effectiveness from 70% to 90% (20% gap). The proportion of saline groundwater desalinated needs to rise from 10%

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to 90% (80%) and the desalination effectiveness from 50% to 90% (40% gap). Similarly to Jordan, a 50% gap exists in the effectiveness of aquaculture water treatment, as it is not yet practiced in Palestine.

- The '**water demand for irrigation**' indicators assess the quantity of water supply, the use of alternative water sources and their management. In Jordan, the water supply needs to rise by 196 MCM/year. The next indicators indicate how this rise could be implemented. The reuse of treated wastewater for irrigation needs to increase from 42 to 70% (28% gap), the use of desalinated water from 5% to 10% (5% gap) and the use of alternative water supplies from on-farm water harvesting from 3% to 10% (7% gap). Overall, the implementation of integrated water resources management shows a 30% gap. Also, a 30% of the irrigation water is currently lost due to infrastructural problems and there is a target to reduce this percentage to 15% (15% gap). In Palestine, the gaps for covering the future water demand are even wider. The quantity of water supply is currently at 52 MCM/year and the objective is to increase it to 182 MCM/year (130 MCM/year gap). The losses in the irrigation network need to be reduced from 40% to 15% (25% gap). The proportion of treated wastewater that is reused for irrigation need to rise from only 2% to 30% (28% gap), the use of desalinated water from 1% to 5% (4% gap) and the use of alternative water supplies from on-farm water harvesting from 2% to 10% (8% gap). Overall, the degree of implementation of integrated water resources management is currently 20% and the target is to rise to 80% (60% gap).
- The indicators of the goal '**Ensure agricultural development**' (prioritized by Jordan and Palestine) assess mainly socio-economic gaps in the agricultural sector. In Jordan and Palestine, the average annual income of small-scale food producers exhibits a 3500 USD and 4440 USD gap respectively. Small-scale farmers are among the most vulnerable and face significant economic challenges. Studies indicate that smallholder farmers in Jordan and Palestine often earn much less than the national average income due to factors such as limited land ownership, water scarcity, and reliance on low-value crops (Sergaki et al., 2020). In Jordan, the proportion of farmers participating in cooperative agricultural schemes need to rise from 10% to 30% (20% gap), while Palestine has set a more ambitious target, necessitating an increase in the proportion from 10% to 50% (40% gap). Next, two qualitative indicators have been assessed with a 5-point Likert scale (from 1-Very poor to 3-Acceptable to 5-Very good). The total official flows to the agricultural sector are currently considered 'poor' both in Jordan and Palestine, while the desired target is 'good', exhibiting a gap of 2 points in the Likert scale. Also, the capacity building actions in the two countries are deemed as 'poor' and the target is to improve them to a 'good' state, indicating again a 2 points gap in the Likert scale.
- The goal to '**Ensure soil quality**' has been highly prioritized by the Jordanian stakeholders and the recorded gaps may explain this priority. Currently, 70% of the agricultural land is considered degraded due to low carbon and salinization, and the target is to reduce this

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proportion to 40% (30% gap). Farms applying active carbon addition are currently 25% of the total farms, with an aim to increase this proportion to 50% (25% gap); whereas farms currently using agroecological practices are only 1% of the total farms, with a more moderate aim to increase them to 5% (4% gap). Finally, the productivity yield (crop yield gap[1]) has been currently assessed at 20% with the aim to reduce this gap to 10%.

- Next, the goal to '**Ensure renewable energy availability**' is assessed for Palestine, concluding its gap analysis, and is also assessed as the highest priority goal for Israel. The share of renewable energy in total final energy consumption is currently estimated at 2% in Palestine with an aim to increase this to 33% (31% gap). The proportion of renewable energy over the total energy used in agriculture is currently only 0.2% with an aim to increase it to 20% (19.8% gap). Finally, the status of the electrical grid modernization in Palestine is assessed as 'poor', with a target to improve it to a 'good' state, which is expressed as a 2 point gap in the Likert scale. For Israel, the Renewable energy share in total final energy consumption is currently 7%. The 2030 National Plan has set an achievable target to increase this share to 30%, which indicates a 23% gap. However, energy experts believe that the 2030 goal set by the government is too conservative and that a much higher goal could be achieved by utilizing solar and waste-to-energy technologies. According to this more ambitious approach, the renewable energy share could be increased to 90%, resulting in a much larger, 83% gap. This example clearly indicates how a larger gap (compared to the respective gap of Palestine) does not necessarily mean a worse current state but rather a more ambitious target. Regarding the proportion of renewable energy over the total energy used in agriculture, again two targets are presented for Israel: the 2030 government target is to increase this share from 10% to 30% (20% gap), whereas the more ambitious experts' target is to increase it to 90% (80% gap). According to the latter, agrivoltaics and reservoir coverage with solar panels offer opportunities to go far beyond the government's conservative 2030 goal in the agricultural sector. As for the electrical grid modernization status in Israel, it is considered to be 'good', necessitating only some infrastructural improvements to meet the 2030 (and beyond) demand.

The gap analysis results that we discuss below concern the remaining goals that are highly-prioritized by Israel.

- '**Climate change adaptation and mitigation**' indicators assess the policies and interventions towards this goal. The existing policy for climate change is considered 'poor' in Israel, highlighting the need for passing a Climate Change Law. Capacity building actions for climate change adaptation and mitigation are considered good at

[1] The crop yield gap is estimated as the difference between average simulated yield potential (Yp, crop production without water stress) or water-limited yield potential (Yw, rainfed crop production with water stress) minus the average on-farm actual yield.

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a local scale but poor at a national scale, as there is currently no national masterplan for climate change capacity building. Finally, actions for carbon removal/storage in vegetation or soil are currently assessed as 'acceptable', considering the forestry activities of the KKL-Jewish National Fund, but need to be considerably improved, e.g. through the passage of a Climate Change Law, the establishment of an Israeli carbon trade market and the establishment of a carbon tax.

- '**Development stresses mitigation**' indicators assess issues of competition between development and land conservation. Urban population in Israel has been recorded as 92% of the total population increasing with a 2% urbanization rate (2022 records). The current local urban population is 60,000 in the Valley of Springs and 11,000 in Beit She'an, and expected to rise to 70,000 and 20,000 respectively. Such urbanization trends are potentially jeopardizing land planning and conservation. The proportion of natural and protected areas is currently estimated at 65.8% with a target to maintain steady state in the coming years. While this is a no-gap result, it does not mean that no interventions are required to maintain the current state of the indicator, since the development stresses are expected to be increasing, potentially putting at risk national and protected areas. Finally, the existing regulations for land planning and conservation are considered 'adequate' at a local scale, with a target to improve them by implementing the existing plans, and 'poor' at a national scale, as there is no national master plan for land conservation.
- Finally, the indicators for **'Biodiversity loss mitigation'** assess the regulations and actions for the achievement of this goal in Israel. Current regulations and actions for biodiversity conservation are assessed as 'acceptable' with a target to improve them to 'good' by implementing the National Plan for Biodiversity. Current protection of native species by the Israel Nature and Parks Authority (INPA) is assessed as 'good', with a target to maintain the same state in the future (no gap), whereas the control of invasive alien species at an national scale is considered 'poor', requiring the implementation of the National Plan for Biodiversity.

Overall, the priorities as well as the capacities across the three territories of the Jordan Valley have proved substantially different. While the Jordanian and Palestinian stakeholders mostly share common challenges and capacities, the image formed for the WEFE nexus in Israel differs substantially. Additionally, Israel may present wide gaps for some indicators but this is also due to its more ambitious objectives, which are partially based on its higher capacity to reach them, as it has been assessed in the previous phase. On the other hand, the wide gaps that are present for Jordan and especially Palestine, are mainly due to the adverse current state that they experience regarding the examined indicators.

Furthermore, the living labs have highlighted different drivers causing pressures at the WEFE nexus across the three territories. For example, in Jordan, water scarcity is mainly the outcome

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of migration-led population growth, and the non-enforcement of regulations. On the contrary, Israeli regulations are largely enforced, but they are outdated in the context of current challenges and do not take into consideration NBS. The reuse of wastewater from the fishponds in agriculture, for example, is very limited due to strict regulations on water quality. The dual use of agricultural land for producing solar energy from PV, agrivoltaics, is limited by arbitrary limitations on the percentage of agricultural land which can be fitted with solar panels. Whereas in the Palestinian JV area, the main pressure is considered to be the Israeli occupation, which necessitates Israeli approval for accessing vital resources. Therefore, the specific solutions and strategies that will be proposed at the next phase of the project should consider and reflect these disparities in drivers, challenges, capacities and gaps.

The methodology of the gap analysis implemented here functions as a preparatory step for the assessment and selection of specific WEFE solutions to address the challenges in the region. The outcomes of the GA will inform the decision criteria, indicators and weights that will be needed for the Multi-Criteria Decision Analysis application in the next phase of the project. At this stage, based on the recorded gaps of the GA, and on the drivers identified during the CLD analysis, a first set of potential solutions has been formulated as follows.

The drivers that are linked to the WEFE challenges, as they have been identified during the co-creation of the CLD, and enriched with the insights gained from the mapping of the WEFE resources and the CCA, are presented in Table 4. Linking WEFE challenges with their drivers is an important step for the identification of potential solutions and their assessment (Pellegrini et al., 2023). Subsequently, these challenges and their drivers have been associated with potential NBS and strategies applicable to the JV. These NBS and strategies have been informed by the methodologies developed in the Prima project 'LENSES' and the H2020 project 'ThinkNature' for the design of NBS. Particularly, the NBS tool presented in (Vanino et al., 2024) includes a comprehensive list of NBS, supplemented with detailed information on their type, ecosystem services, challenges addressed, and alignment with Sustainable Development Goals (SDGs). Potentially applicable solutions and strategies have been selected from this list as follows:

- The Protection and Conservation strategies in terrestrial ecosystems outlined in Table 4 include among other the following potential NBS: limiting or preventing specific uses and practices, ensuring continuity within ecological networks, protecting forests from clearing and degradation, maintaining and enhancing natural wetlands, and establishing a robust Natural Protected Area network structure. These strategies form the foundation for the effective protection and conservation of terrestrial ecosystems, ensuring their sustainability and resilience in the face of environmental challenges.
- The Monitoring category of NBS encompasses the assessment of NBS benefits, ecosystem services valuation methods, and the use of bio-indicators.

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- Meanwhile, Agricultural landscape management can incorporate various practices, including agro-ecological practices, grazing management and animal impact as tools for farm and ecosystem development, crop rotation changes, soil improvement and conservation measures, increasing soil water holding capacity and infiltration rates, establishing agro-ecological network structures, mulching, incorporating manure, compost, biosolids, or crop residues to enhance carbon storage, integrating biochar into agricultural soils, enrichment planting in degraded and regenerating forests, creating forest patches, hedges, and planted fences, as well as implementing soil conservation techniques such as cover crops, windbreaks, minimum or conservation tillage, and agroforestry.
- The Ecological Restoration of Degraded Terrestrial Ecosystems category can incorporate the following NBS: phytoremediation, erosion control systems, soil and slope revegetation, and the planting of trees, hedges, or perennial grass strips to intercept surface runoff.
- As part of the Restoration and Creation of Semi-Natural Water Bodies and Hydrographic Networks, the following NBS can be included: restoring wetlands in groundwater recharge areas, reconnecting rivers with floodplains to enhance natural water storage, re-vegetating riverbanks, re-meandering rivers that have been artificially straightened to reduce the speed and height of flood peaks, restoring grasslands or low-input arable land in drinking water catchments, creating targeted ponds or wetlands to trap sediment and pollution runoff in agricultural landscapes, constructing wetlands and other built structures for water management, re-opening blue corridors, and implementing floodplain restoration and management. In the category of Wastewater Treated Effluent Improvement, potential NBS include using biofilm-based technologies for wastewater treatment, harvesting rainwater for greenhouse irrigation to reduce soil salinization, and employing engineered reedbeds or wetlands for tertiary treatment of effluent.

This initial set of solutions represents a preliminary version of the program of measures, which will be further analyzed and refined in the next phase of the project to provide strategic insights for the region. With the completion of the gap analysis, the first phase of stakeholder engagement for the development of the Strategic Plan for climate change adaptation and mitigation has been completed and EcoFuture's consortium will move into the next phase to co-design with the stakeholders the alternative solutions.

5. Conclusions

Overall, the priorities as well as the capacities across the three territories of the Jordan Valley have proved substantially different. While the Jordanian and Palestinian stakeholders mostly share common challenges and capacities, the image formed for the WEFE nexus in Israel differs substantially. Additionally, Israel may present wide gaps for some indicators but this is also due

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to its more ambitious objectives, which are partially based on its higher capacity to reach them, as it has been assessed in the previous phase. On the other hand, the wide gaps that are present for Jordan and especially Palestine, are mainly due to the adverse current state that they experience regarding the examined indicators. Therefore, the specific solutions and strategies that will be proposed at the next phase of the project should consider and reflect these disparities. It is crucial to design interventions that not only address the identified priorities but also consider the existing differences in capacities. A comprehensive approach should include, among others, targeted training programs, improved access to modern technologies, and enhanced understanding of regulatory frameworks.

Concluding, we need to note that the implementation of this framework took place under the most adverse conditions, considering the ongoing Gaza war. Nevertheless, thanks to the uninterrupted commitment of the consortium partners, it has provided a systemic and inclusive overview of the WEFE nexus in the region, of what are the most important challenges for each territory, their priorities, drivers and leverage points, and of the directions in which the forthcoming solutions and strategies should move.

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Project Partners

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