Attachment 1

Al-Muwaqqar Research Station Initiative: Advancing Water and Land Resource Development for Sustainable Dryland Ecosystems

The issue of the sustainability of natural resources in dry areas and their rehabilitation occupies an advanced position in the list of national priorities for the development of Jordanian. These areas are critical for food production, achieving food security, and fostering the growth of local communities in Jordan. The vast Badia region, occupying over 90% of Jordan's area, serves as a primary center for raising sheep and goat herds and hosts extensive natural pastures, which are a renewable and vital source for pastoral animal production. Additionally, the region supports various economic and agricultural activities related to plant production systems, which directly or indirectly impact the well-being of the Badia inhabitants. Furthermore, the agricultural sector in Badia significantly contributes to enhancing food security, boosting the domestic economy, and raising the living standards of the local population by generating employment opportunities and empowering women and youth within their societies.

Still, the over exploitation of natural and water resources, improper agricultural practices, and the adoption of farming patterns that are not suitable for local environments have led to evident deterioration in the Jordanian Badia. Such factors have negatively affected the agricultural sector and have clearly resulted in the deterioration of land, degradation of natural pastures, salinization of agricultural lands, deterioration of soil health, loss of biodiversity, and depletion of the main water basins. This has collectively negatively impacted local communities and contributed to the spread of poverty and unemployment. Hence, there is an urgent need to adopt a new methodology for the development of the Jordanian Badia that is based on well-established scientific and research principles. Such an approach should prioritize the optimal and sustainable use of resources with a focus on creating an integrated environment across different sectors to positively impact local communities in the Jordanian Badia.

The rehabilitation and restoration of natural resources in the Badia region are fundamental to achieving several UNDP Sustainable Development Goals (SDG-2030). This approach aligns with two major goals: No Poverty (SDG-1) and Zero Hunger (SDG-2), as it can contribute to improving livelihoods and ensuring food security for Badai inhabitants. Moreover, the approach aligns with SDG-8 (Promoting Decent Work and Economic Growth) to create sustainable livelihood opportunities in the dryland regions by empowering local communities to be able to make changes and shape their own prosperous futures. Additionally, by striving to Reduce Inequalities (SDG-10), the approach ensures that the benefits of sustainable resource development are equitably distributed among different segments of society. This inclusivity empowers marginalized communities and promotes social cohesion, leading to a more resilient and prosperous living environment and the reverse migration of local communities to the Badia region. In line with the vision of Climate Action (SDG-13), the approach will take significant steps to mitigate the environmental impact of resource utilization in dry areas. This could be achieved by implementing water conservation practices, restoring degraded land, improving soil health, and conserving biodiversity. Moreover, the emphasis on sustainable pastoralism and water and land management helps to restore ecosystems, sequester carbon, and preserve biodiversity, contributing to climate resilience in the region as it adapts to the challenges posed by climate change. Finally, this approach will contribute to "Life on Earth" (SDG-15), where a comprehensive approach to ecosystem restoration and preservation will be deployed. Thus, protecting and rehabilitating natural pastures and reintroducing Badia native plants will ensure sustainable production of pastoral animal resources while safeguarding the delicate balance of the local ecosystem. This, in turn, contributes to the long-term viability of the region's biodiversity and ecological health.

Al-Muwaqqar Research Station was established in the 1980s as a research and training site affiliated with the School of Agriculture at the University of Jordan (Figure 1). Its main objectives were to conduct research and practical experiments in dry areas and to develop the surrounding region into a model for sustainable development related to environmental, agricultural, and pastoral systems in the Jordanian Badia. Previous research at the station focused on rehabilitating natural pastures by developing the natural vegetation cover and implementing water harvesting techniques, along with cultivating shrubs for improved forage production. These agricultural activities relied on surface runoff water from a portion of the catchment area of Al-Muwaqqar, which was collected behind three small dams with a total storage capacity exceeding 75,000 cubic meters annually. The station covers an area of approximately 196 hectares, which can be divided into three main zones

based on their natural characteristics: the grazing area, the flat land, and the dams. The grazing area is located in the northern part of the station, dominated by plants typical of desert and semi-desert regions, and it receives surface runoff water from the northern part of the catchment area of Al-Muwaqqar. The flat land lies between the grazing area and the dam zone and is devoid of plants except for some saltbush shrubs remaining along contour lines. The dam zone comprises three water reservoirs: the first one is located in the southern part of the station, while the second and third are situated in the western part. The three small dams were constructed along the path of the floodwater coming from the southern part of the catchment area of Al-Muwaqqar and are often filled multiple times during the rainy season. However, there is a need to develop and introduce new methods to maximize the utilization of water from these dams immediately after their filling.

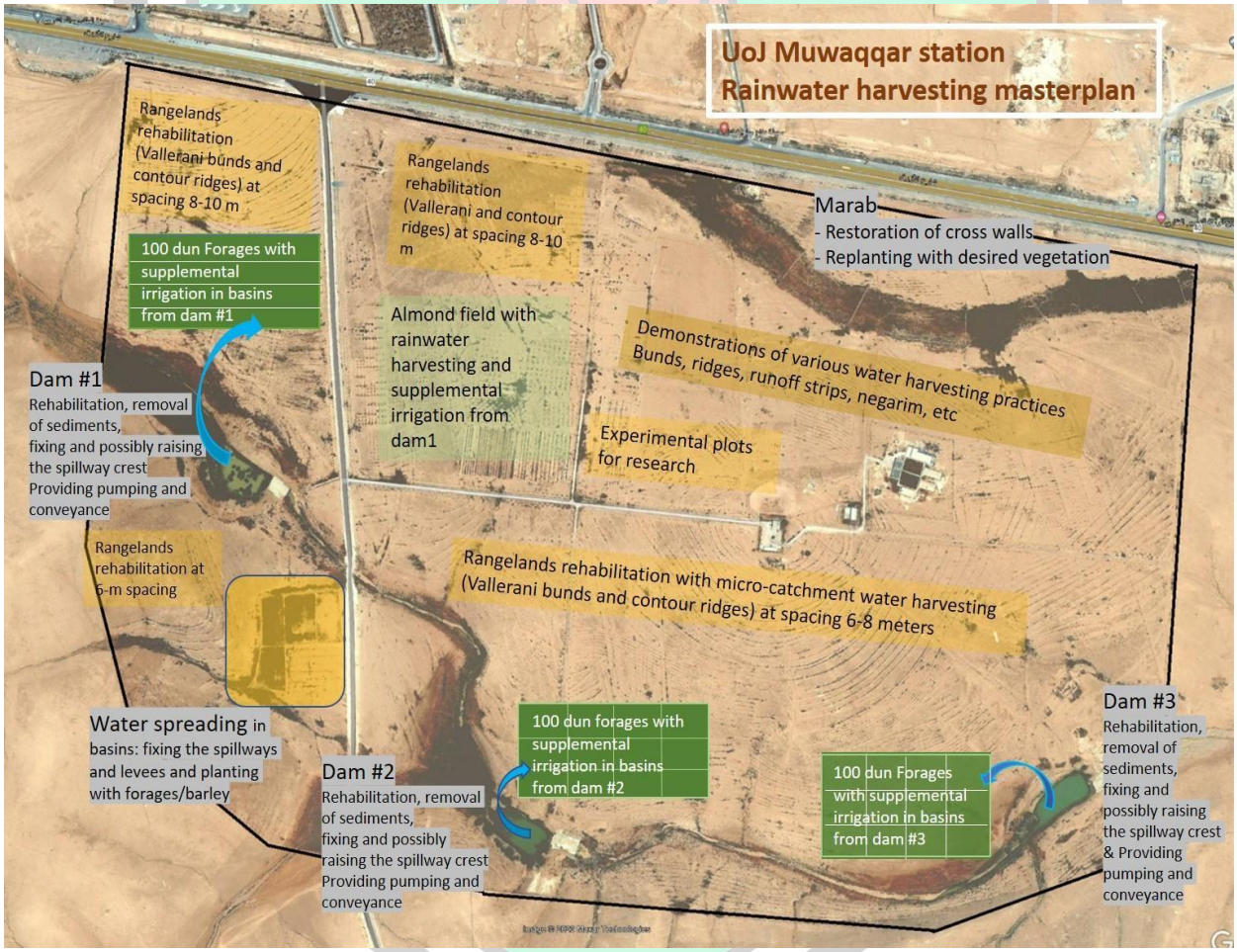

Figure 1. Al-Muwaqqar Research Station land use map. (Source: Dr. Theib Awiss)

Despite its nowadays considered an abundant pastoral land, the Al-Muwaqqar Research Station has encountered considerable challenges and experienced substantial land degradation over

the past years (Figure 2). As described earlier, the station's water resources primarily rely on surface runoff collected from the Al-Muwaqqar watershed through three small dams. However, the storage capacity of these dams has been adversely affected by sediment accumulation over the years. Thus, urgent action is required to remove the sediments as soon as possible to restore their full water storage capacity and use stored water for different agricultural activities. Moreover, innovative solutions are necessary to optimize water harvesting from the Al-Muwaqqar watershed, including the construction and restoration of agricultural ponds near each dam to facilitate later use for crop and forage cultivation (Figure 3).

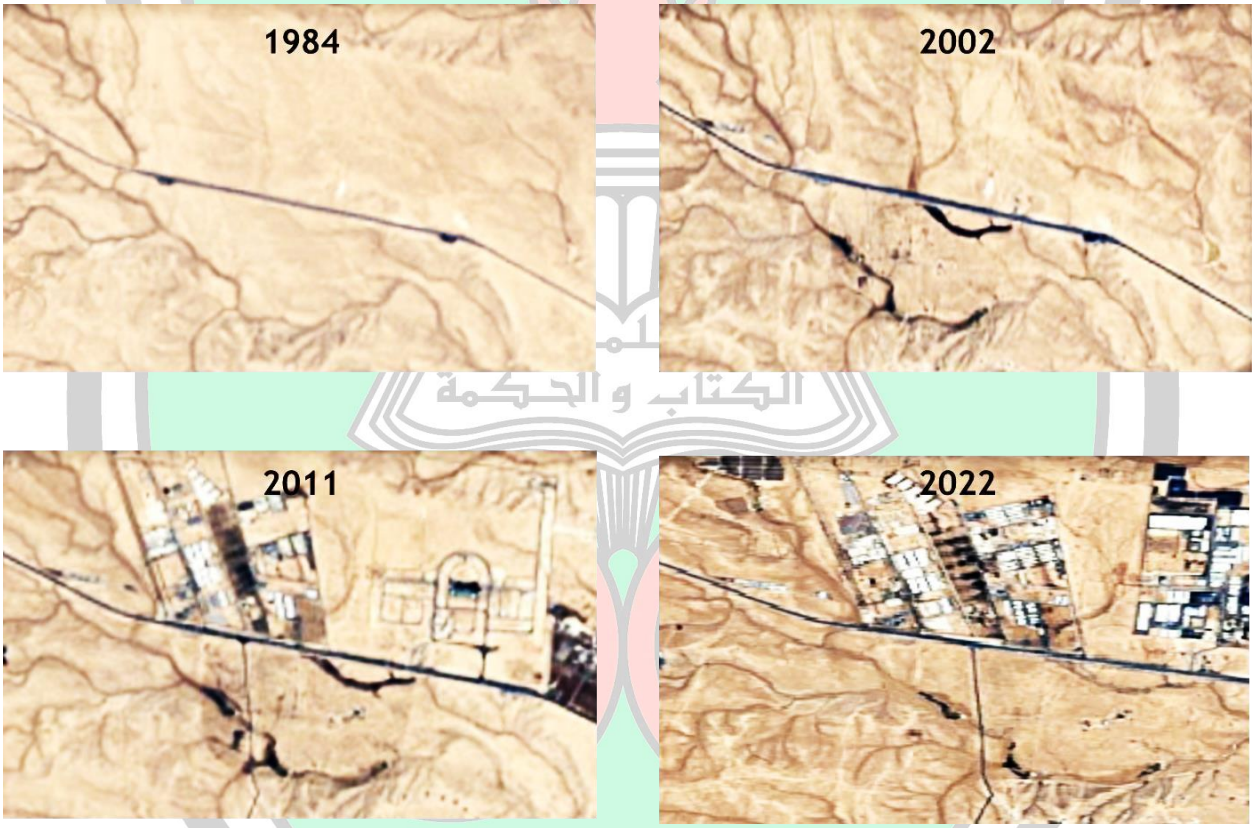

Figure 2. Time-line of Al-Muwaqqar Research Station showing land degradation over the years. (Source: Google Earth)

Additionally, the underground well, excavated and prepared several years ago, remains nonfunctional and necessitates immediate maintenance and activation to address water scarcity concerns. Soil health deterioration associated with severe compaction and crusting occurred due to overgrazing and intensive plowing over the last decade and there is an urgent need to restore soil

health using suitable cropping system, reforestation, and utilization of innovative solutions such as regenerative and organic agriculture systems. The grazing areas within the station (Marab and other areas) have also suffered from degradation, with shrubs facing destruction, particularly in proximity to the grazing area and areas near the dams. Furthermore, extensive plowing practices have been implemented, especially in the grazing area adjacent to the second dam towards the third dam, resulting in a significant loss of vegetation cover. Overall, the Al-Muwaqqar Research Station confronts a multitude of pressing issues concerning water resources, land degradation, and inappropriate land utilization practices that demand swift attention to ensure its long-term sustainability and restoration.

Figure 3. Small agricultural pond harvesting runoff water from the second dam in Al-Muwaqqar Research Station. (June 2023; Source: Dr. Ayed Al-Abdallat)

From this perspective, the "Al-Muwaqqar Research Station Initiative" was created with the vision of transforming it into a knowledge lighthouse in dry areas, serving as a dynamic innovation lab for future research and generating long-term and sustainable impacts on the local communities residing in the Badia region. The initiative endeavors to create a thriving environment where innovative ideas are implemented, leading to positive and lasting changes and devising sustainable strategies for the restoration of degraded lands and ecosystems in dry areas. This will be achieved

by harnessing scientific research and innovative practices and knowledge transfer, which will pave the way for enduring positive changes in the region's arid landscapes.

The "Al-Muwaqqar Research Station Initiative" aims to address the issue of the sustainability of natural resources in the dry areas of the Jordanian Badia region as a model for land restoration in other parts of the region. It presents an all-encompassing approach for the rehabilitation and restoration of degraded land, leveraging cutting-edge scientific tools and recent innovations in the field. This initiative seeks to alleviate the challenges posed by overexploitation of water and improper agricultural practices that have led to the deterioration of land resources and negatively impacted the land and the well-being of local communities. The main objective of this initiative is to develop an integrated and sustainable approach that restores degraded land and water resources to maximize the potential of such resources for the welfare of the Badia inhabitants and achieves broader sustainable development goals. This approach should integrate local knowledge and harness new technologies and innovations based on sound scientific and environmental principles that have proven effective in developing and sustaining natural resources in dry areas. To ensure the success of this methodology, collaboration with international donors, local stakeholders, NGOs, governmental institutions, and international organizations is essential. By partnering with these entities, the full potential of expertise and financial resources can be utilized to create a comprehensive roadmap for advancing the agricultural sector and preserving natural resources in the Jordanian Badia. This collaborative effort will pave the way for sustainable development and prosperity for the region's communities.

Currently, there are several research proposals and initiatives under preparation and ongoing:

1. INWRDAM and JU imitative to Restore Al-Muwaqqar Research Station: Ongoing.
2. The Hashemite Fund for Development of Jordan Badia and JU initiative to Restore Al-Muwaqqar Research Station: Ongoing
3. Development and Sustainability of Water and Pastoral Resources at the University of Jordan Dry Land Research Station (Al-Muwaqqar Station), Submitted to the Ministry of Environment.
4. Implementation of innovative farm platforms in the Mediterranean to REVERSE and prevent land degradation Submitted to PRIMA-Med and passed the pre-proposal phase.

5. Innovation Tools for Soil Health Restoration for Dryland Ecosystems: in preparation and will be submitted to the Scientific Research Fund of the Ministry of Higher Education.