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SUB-PROJECT

**RESTORATION OF BADIA ECOSYSTEM SERVICES FOR ENHANCED COMMUNITY LIVELIHOOD.
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ACTIVITY A6:

**DEVELOP METHODS FOR INTEGRATED ASSESSMENT OF RESTORATION INTERVENTIONS
(IMPACT ON SOIL AND ECOSYSTEM FUNCTIONS) AT BADIA SCALE AND AT EXPERIMENTAL
SITE SCALE.**

An Activity led by CLAUDIO ZUCCA, PhD

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**“Types of soil and water conservation (SWC) and water harvesting (WH)
interventions implemented in Jordan Badia”**

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¹ International Center for Agricultural Research in Dry Areas (ICARDA). Rabat, Morocco.

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Foreword

This research activity titled “ACTIVITY A6: DEVELOP METHODS FOR INTEGRATED ASSESSMENT OF RESTORATION INTERVENTIONS (IMPACT ON SOIL AND ECOSYSTEM FUNCTIONS) AT BADIA SCALE AND AT EXPERIMENTAL SITE SCALE” was funded as part of the Project titled “Sustainability and Operationalization of Established Regional Agricultural Research Centers in Five Arab Countries” (sub-project “Restoration of Badia ecosystem services for enhanced community livelihood”), granted by the Arab Fund for Economic & Social Development (AFESD) and implemented by ICARDA.

This research was started in the last quarter of 2016 as a response to the perceived need to launch interdisciplinary research to identify approaches to enhance the effectiveness of the on-going efforts to mitigate land degradation in Badia and to restore rangeland productivity. The goal of this specific activity is to evaluate methods to enable an evaluation of the impacts of the interventions conducted so far.

This report summarizes the work done during 2017 to elaborate a typology of the SWC and WH structures implemented in the Badia rangelands, based on both literature and remote sensing evidence, as part of Activity A6.

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1. Introduction

The so called “Badia” region of Jordan is characterized by arid rangelands and deserts which cover about 80% of the country area and extend to the south and to east in continuity with the Saudi and Iraqi steppes and deserts. It is characterized by hot-dry summers and cold-dry winters, and by an average annual rainfall of 50 to 200 mm with high interannual variability. The increased demand for meat in the region has driven an increase in livestock numbers, particularly the number of sheep and goat witnessed a continuous increase since 1990. Increasing cultivation (e.g., barley) brought into production lands from steppe and desert rangelands that were in some cases not suited to cropping. The increase in grazing pressure and cultivation of traditional and fragile grazing lands has led to severe degradation of these resources.

Several policies and programmes have been implemented in Jordan during the recent decades to mitigate degradation and to restore rangeland productivity (Zucca and Bartolini, 2017). In the frame of these, a wide range of sustainable land management (SLM) practices have been applied, which could be summarized as follows:

- Restoration of community rangeland governance and management practices, including rotational and seasonal grazing patterns;
- Improving management of ruminant animals including veterinary services and awareness programs on animal diseases;
- Rehabilitation/re-vegetation of degraded rangelands;
- Soil conservation and water harvesting measures in agro-pastoral and crop areas (e.g., terraces, contour structures and tillage, stone walls);
- Maintenance of stream beds and rehabilitation of water springs;

This research focused on those categories of interventions that were conducted most extensively in Badia and that have the characteristic of being sufficiently recognisable/trackable on satellite images, to create a solid framework for the establishment of a sound dataset.

Most of them involved the establishment of soil and water conservation (SWC) and water harvesting (WH) structures that maintain their efficiency in the landscape for several years.

2 Types of soil and water conservation (SWC) and water harvesting (WH) interventions

Contour structures (CS and CSb).

Contour structures represent the most frequent governmental intervention of the BRP-CAP. These consist of linear micro-catchment interventions characterized by ridges and furrows traced along the contour lines, where drought tolerant shrubs species (e.g., *Atriplex* species) are planted in ridges to provide a source of fodder for livestock. The management of the planted area after the intervention is in charge to the local population or to the government, depending on the agreements set by the different interventions. We identified two types of interventions, although from the satellite images it is not always possible to distinguish clearly between the two:

Continuous Contour Structure (CS): this type of contour structure is established by a continuous ridge and furrow excavation along the natural contour of the slope.

Discontinuous Contour Structure (CSb): this type of contour structure is established by an intermittent pit excavation along the natural contour of the slope, done by means of a Vallerani² machine.



Continuous Contour Structure

² <http://teca.fao.org/read/8757>



Discontinuous Contour Structure

Tanks (T).

A tank is an artificial water pond built by private or governmental initiative in order to collect and stock seasonal water flows for agricultural/animal husbandry purposes. Tanks can be observed all along the Badia region. Their technical characteristics can vary, although following a common construction scheme. Tanks are usually squared, built in earth or concrete, and often connected with complementary structures (e.g., runoff diversion structures) allowing to catch the seasonal water-flow and fill the reservoir.



Tank Structure

Dams (DAM).

A dam is an artificial structure typically made of concrete or earth and built to inbound water, creating a permanent or semi-permanent basin along a main waterway to support agriculture in the surrounding area. Dams are relatively big engineering intervention generally of governmental initiative.

Check dams (SB).

Check dams are the most common structures observed in Jordan Badia. Although their specific characteristics can vary, usually check dams are linear structures made of earth (sometimes rock, or concrete), built transversal to the stream flow in the ephemeral river bed (wadi). The main objective of the structure is to slow down the flow of water to increase ground water recharge, and reduce erosion. A check dam increases water infiltration into the soil, and generates a favourable area for cultivation right upstream. The water accumulated upstream sometimes creates a temporary basin. Check dams are often organized as series of structures along main stream beds.



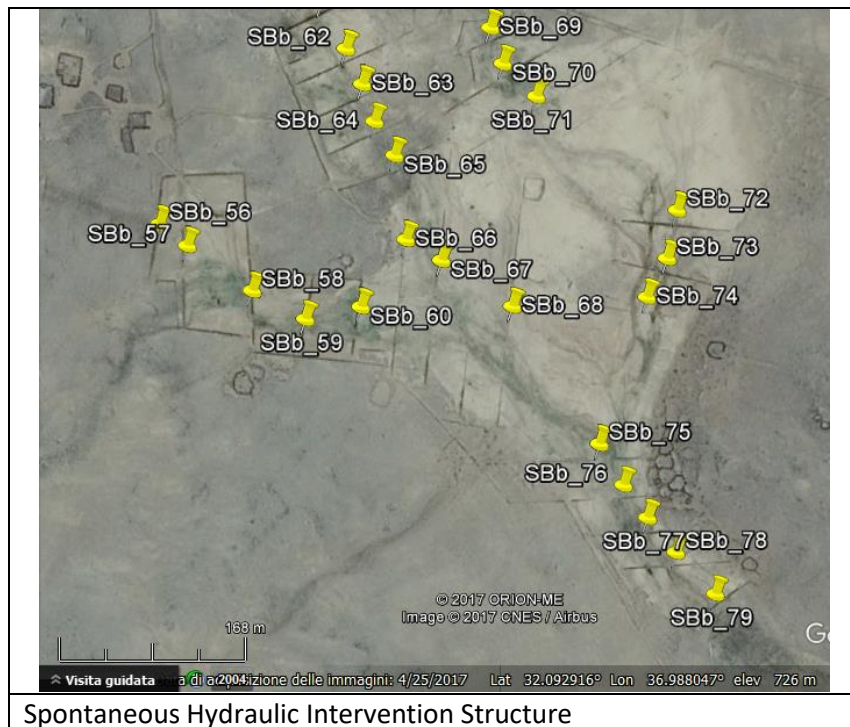
Dam Structure



Check Dam Structures

Spontaneous Hydraulic Interventions (SBb).

This type of intervention, identified on satellite images and named “spontaneous hydraulic interventions” seems to be similar in purpose to the check dams, although it shows a more irregular structure and distribution pattern. These structures are often closely connected with other agricultural structures (like property boundaries) and were probably established by private farmers. The definition of this type of intervention will be refined after data validation in the field.



Spontaneous Hydraulic Intervention Structure

Reforestation interventions in the highland area (REF).

In the highland region at the fringes of Badia several large-scale interventions were identified that are most likely reforestation sites, showing various degrees of vegetation (trees and/or shrubs) development and spatial uniformity.

All the interventions are located at an elevation ranging between 600 and 1300 m.a.s.l. With one exception, they share a common structure and they are organized in several clusters implemented approximatively at the same time. The structure shows land works following the contour lines along the slopes, where trees were established. Base on their size and on the regularity of the pattern, they seem to be of institutional nature.



Reforestation intervention in highlands

Interventions of unclear purpose located in the easternmost sector of Badia under hyper arid conditions (DR, DRb and AR).

In the North-Eastern corner of the Mafraq governorate, in the desert region along the borders with Syria and Iraq, additional types of possible “restoration” interventions (DR, DRb, and AR), were identified, which identification/interpretation remains uncertain and needs validation.

DR. This category, generally named as “desert restoration”, includes series of parallel linear structures drawn at a distance of around 15-25 m or 20-30 m from each other in the mostly rocky landscape, often in depressions or concavities that appear to be covered by sand deposits. Hence their interpretation as dune fixation structures or more generally as sand stabilization measures. However, their prevailing E-W direction does not seem directly related to the wind direction. In some cases they were built in the wadi beds perpendicular to the flow direction and possibly had an aquifer recharge function. In the latter case the average distance between the lines is bigger (30-40 m).

DRb. In two sites, there seem to be examples of afforestation interventions conducted in desert environment, with linear structures following the contour lines. The interventions

were made on gently sloping rock outcrops and the distance between the lines varies between 25 to 50 and up to 80 m. No evidence of vegetation development was observed in the available images (2004 and 2005).



AR. These structures, tentatively interpreted as “aquifer recharge” structures, are made of holes distributed in a regular grid pattern along a major wadi bed, and associated with other linear structures such as the DR mentioned above, or check dams and/or tanks. They have been identified in a single site but over a relatively large area, in a wide ephemeral stream where a stratification of soil and water conservation interventions was implemented. The pattern is either characterized by a regular grid (holes at around 20 m from each other), or by clusters of four holes forming squares distributed in a regular grid (10x10 m, 15 between squares).



References

Zucca C., Bartolini P. (2017). Summarized review of the recent rangeland restoration policies and programs conducted in Jordanian Badia. Technical report. “Sustainability and Operationalization of Established Regional Agricultural Research Centers in Five Arab Countries” Project. International Center for Agricultural Research in Dry Areas (ICARDA). Rabat, Morocco.