Chapter 7

Mohamed Ouessar¹, Adriana Bruggeman², Rabi Mohtar³, Dalel Ouerchefani¹, Fethi Abdelli¹ and Mohamed Boufelgha⁴

Abstract  In the arid regions of Tunisia, huge efforts are being made in the construction and maintenance of water harvesting and soil conservation structures. A growing need for their evaluation and assessment of their impact is felt. To this end, a simple tool has been developed and applied to evaluate the structural stability of jessour, tabias and gabion check dams. The total gives a measure of the structure’s present-day overall condition based on physical inspection of a number of key characteristics vital to its functionality. The evaluation tool was applied to a random sample of structures in southern Tunisia. This paper also describes an adaptation and evaluation of the ArcView soil and water assessment model (SWAT) for the assessment of the hydrologic impact of water harvesting systems. Some modifications were made to the model code to adapt the model to the processes in the study area. Evaluation of the hydrologic goodness-of-fit of the model based on the observed and simulated runoff data in the study site, using four statistical criteria, gave reasonable results.

Keywords  Water harvesting structures, evaluation tools, SWAT modeling

1 Introduction

Traditional water harvesting techniques existed for decades in Tunisia for soil and water conservation in support for agricultural production (El Amami, 1984). Advantages of water harvesting include groundwater recharge, increased crop production and soil conservation (Prinz, 1996). Currently, the Tunisian authorities are evaluating the need for additional construction and maintenance of these structures.

---

¹Institut des Régions Arides (IRA), 4119, Médenine, Tunisia
²International Center for Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria
³Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, IN, USA
⁴Commissariat Régional au Développement Agricole (CRDA), Route de Tataouine, 4100 Médenine, Tunisia
An evaluation that assesses the water harvesting structures would aid decision-makers in supporting the construction and maintenance of these structures.

Being aware of the importance of natural resources in those arid environments, the Tunisian Government has initiated a vast programme for the conservation and mobilization of those resources. In the Jeffara region, which encompasses the study site, huge works for soil and water conservation (water harvesting) have been implemented whose immediate effects are visible but their efficiency in both the short and the long term need to be assessed and evaluated in detail (De Graaff and Ouessar, 2002). By simplifying and simulating natural processes, models have become efficient tools for analyzing the impact of land use changes and the development of management practices.

The first part of this paper discusses the development and application of an evaluation tool to evaluate the structural efficiency of three of the most commonly used water harvesting structures in southern Tunisia, the jessour, tabias and gabion check dams (Ben Mechlia and Ouessar, 2004). The second part describes the adaptation and evaluation of the GIS-based SWAT model for the assessment of land use change impact in an arid watershed in southeastern Tunisia.

Other research activities related to the impact of water harvesting practices in southern Tunisia, but not presented in this paper, include: the evaluation and development of alternative designs for recharge wells, which were constructed in the wadi bed upstream of some of the gabion check dams to improve groundwater recharge; and the application of detailed models to simulate the impact of water harvesting structures on hydrological, erosion and sedimentation processes, as well as the water availability for upstream and downstream areas. Coupled with the assessment tool, this integrated hydrological tool is expected to assess the feasibility of maintaining these structures at the farm and watershed levels.

2 Materials and Methods

2.1 Study Site

The application was carried out for the Wadi Oum Zessar watershed, which covers about 336 km² (Fig. 1). The watershed is located in southeastern Tunisia and has an arid Mediterranean bioclimate with an annual rainfall ranging between 150 and 230 mm. The watershed starts at the Matmata mountain range (Kef Ennsoura) and ends in the Mediterranean Sea. It has three main tributaries: Wadi Nagab, Wadi Moggar and Wadi Hallouf. The hydraulic history of this watershed is very ancient and rich, as witnessed by the remains of a dam built in the Roman era near the village of Koutine, and the ancient terraces encountered in the hills of Wadi Nagab. At present, the upstream area is terraced with jessour, which are ancient water harvesting techniques constructed in the form of small earthen retention dams with spillways typical for the mountains of southeastern Tunisia (El Amami, 1984; Ben Mechlia and Ouessar, 2004). The intermediate zones incorporate tabias, which are similar to