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An integrated approach to select and characterize benchmark watersheds for sustainable resources management in Libya

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Abstract

The arid regions suffer from chronic water shortage with obvious impact on sustainable agricultural development. Libya faces severe water shortages and has invested heavily in developing and transferring non-renewable water resources. Rainwater harvesting can improve the productivity of rainwater and maintain productive and sustainable agro-pastoral systems in marginal environments. It could also control soil erosion and reduce the impact of drought. The potential of rainwater harvesting to mitigate the spatial and temporal variability of rainfall has brought about its revival during the last two decades. Supplemental irrigation is another option to improve land and water productivity in the rainfed systems by applying limited amounts of water during dry spells.

Sustainable implementation of these options become more urgent within the expected scenarios of climate change, where rainfall is expected to decrease and the probability of extreme storm events is expected to increase. One reason for low adoption of successful land and water management practices is the lack of systematic knowledge on the selection of appropriate sites and suitable interventions for each biophysical and socio-economic setting. The first objective of this research is to develop and implement an integrated approach for the selection and characterization of benchmark watersheds. The benchmark watersheds are used to undertake research activities inside farmers' fields under "real-Life" conditions, and to develop, test, adapt, and evaluate improved agronomic, genetic and natural resources management practices and technologies.

The study areas of the project in the eastern and western parts of Libya were determined based on 'agricultural regions' mapping results. Data to characterize the existing biophysical and socioeconomic conditions of all watersheds in the study areas were collected from various sources and were matched with the selection criteria. This includes rainfall, cropping (production) systems, communities (rural settlements), accessibility and visibility, topography and soil. A number of watersheds were identified as being potentially suitable for rainwater harvesting and supplemental irrigation practices. An inter-disciplinary team of researchers undertook several visits to potential watersheds and identified the most suitable watersheds. One important feature of the selection process is the integration of various disciplines through the interactive participation of an inter-disciplinary team of researchers during all stages of this process, from defining expert selection criteria, data collection, analyses, field visits and final selection. This was supported by full utilization of GIS and remote sensing capabilities to undertake the compilation, harmonization, integration and analyzing spatial and non-spatial data. The iterative nature of the process enables the

adjustment of different criteria and how they were applied to reach at acceptable results that match the ground.

The selected watersheds were characterized based on hydrological analysis using SWAT model to locate sites for large scale rainwater harvesting systems, suitability analyses to identify potential sites for small scale rainwater harvesting and supplemental irrigation and socio-economic conditions. The second research objective is to build a comprehensive database that is useful for watershed monitoring and assessment.. The results of the watershed characterization process indicated that integration of many biophysical elements (watershed characteristics, land suitability and hydrological characteristics) with socio-economic characterization (community distribution and characteristics, accessibility and willingness to cooperate) is crucial to achieve relevant identification of suitable implementation sites. Without this integration, many aspects will be missing and the identified research sites may not be representative of larger study area and therefore, out-scaling of research findings might not be attainable. This integration significantly reduces the time needed to identify potential sites in the field. Furthermore, the results are well documented for future use beyond the project lifetime.

Keywords: suitability analysis, SWAT, watershed characterization, rainwater harvesting, supplemental irrigation, GIS