Technology Fact Sheet for Adaptation

J. Rainwater Harvesting and Storage in Hill Lakes [i]

Technology characteristics	
Introduction	Using hill lakes or earth lakes, to store and release water for irrigation is not a new concept in Lebanon. Specifically, large-scale collection methods such as hill lakes may provide a solution to the summer water shortage experienced by farmers under current and future climate. Hill lakes are made by excavating earth and profiting from impermeable soil layers or plastic membranes to retain water within the excavated volume.
Technology characteristics/highlights	The key of a cost-effective and efficient hill lake relies on the following factors: 1. Soil type (impermeable or not), depth and geology 2. Climate –rain and snow fall amount is crucial, and evaporation should be always lesser than precipitation 3. Topography (slope is required to ensure water runoff capture into the hill lake) 4. Hydrology and runoff characteristics The technology implementation involves the following: 1. Excavation of the area where the lake should take place 2. Installation of lining system (clay, HDPE, etc.) 3. Installation of pump (if it is needed to pump water upstream level) 4. Installation of irrigation network to carry water to farmer fields. The technology characteristics should highlight the following recommendations: 1. Prior to construction of any of the hillside lakes, it is recommended that contractors are trained in construction management with special attention to small dam construction and the installation of high-density polyethylene (HDPE) lining systems. 2. It is recommended that other lining systems be evaluated prior to construction, based on cost constraints. This could include the use of clay, different thicknesses of the HDPE, lighter colored liners to reduce evaporation, etc.
Institutional and organizational requirements	Green Plan is the public institution which has a historical expertise in designing and implementing hill lakes. If the hill lake serves several end users, an organizational requirement is essential to ensure the equity of water distribution.
Operation and maintenance	It is recommended to develop a water management plan at the basin level before hill lakes are proposed and developed. This will allow for a more economical return on investment, a better utilization of water, and reduced environmental impact. Care is required to avoid damage and contamination by people and animals and to keep the catchment area free from vegetation.
Endorsement by experts	Lebanon has almost 50 years experience in hill lake implementation.
Adequacy for current	Fits well, both for present and expected climate

climate	
Scale/Size of beneficiaries group	Several in mountainous areas farmers may benefit from this technology, if the necessary requirements and factors are met.
Disadvantages	The storage capacity of the lake needs to meet the demand for water during extended dry periods. Obstacles which might appear are: - land ownership issues (limited size, more than one owner/user) - high infiltration rates of rainfall in areas underlain by limestone - high construction costs under certain site conditions - lack of trained personnel for construction management and liner installation - limited water supply and uncertainty of rainfall in some areas.
Capital costs	
Cost to implement adaptation technology	The initial cost of storage typically depends on construction quality, hill lake size, and type of lining system. The cost may vary from 6 to 8$/$m^3$, above this rate, the cost-effectiveness is at risk.
Additional cost to implement adaptation technology, compared to "business as usual"	The first year after lining, maintenance of the clay layer might be needed. Plastic membrane renewal, cleaning the hill lake from vegetation is required on a longer basis. However, the cost is minimal.
Development impacts, direct and indirect benefits	
Direct benefits	Increased availability of water resources for crops and livestock. Improved agricultural productivity as the stored water is used to alleviate water shortage in summer, and preserve yields. If water is used for rainfed crops as supplemental irrigation yields might increase by 2 fold. Increased resilience to water quality degradation. Reduced pressure on surface and groundwater.
Reduction of vulnerability to climate change, indirect	Reducing pressure on water resources and increasing water availability will increase the crop, animals and farmers' resilience to climate change.
Economic benefits, indirect	Creation of jobs to support construction of RWH systems and to provide training to users
Social benefits, indirect	It can also provide significant savings for farmers that are sometimes forced to purchase water. Rainwater harvesting and its application to achieving higher crop yields can encourage farmers to diversify their enterprises, such as increasing production, upgrading their choice of crop, purchasing larger livestock animals or investing in crop improvement inputs such as irrigation infrastructure, fertilizers and pest management.
Environmental benefits, indirect	Promotion of rainwater harvesting will enhance groundwater recharge
Local context	
Opportunities and Barriers	Using rainwater harvesting technology therefore offers a real opportunity to increase productivity in regions with low and irregular rainfall. The cost of hill lakes is often cited as a potential obstacle to wider dissemination of this technology. A lack of national policy towards rainwater harvesting could also present an obstacle to widespread implementation, access to funding and technical assistance.
Market potential	The technology has market potential nationwide.
Status	Present in many areas in Lebanon

Timeframe	Immediate implementation (short term).
Acceptability to local stakeholders	Easy to accept for all involved stakeholders.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Adaptation – Lebanon. You can access the complete report from the TNA project website http://tech-action.org/**