Technology Fact Sheet for Adaptation

H. Efficient water use irrigation systems (EWUIS)[i]

Sector : Water/Agriculture	
Subsector : Water use	
Technology characteristics	
Introduction	Efficient water use irrigation systems (EWUIS) integrate different irrigation systems like drip, mini-sprinklers and their variances. These equipments enable more efficient water use when compared to flood or ground irrigation, through minimizing water evaporation and leaching into the group, and by applying water directly to the root area on a timely basis, according to plants need. Therefore, EWUIS do not involve only "hard technologies" or equipments, but also "soft technologies" enabling the monitoring of irrigation according to plant needs and soil condition. Supplementary irrigation for cereals through sprinklers is included within EWUIS. Since plant needs are affected by the type of crop, the vegetation stage and climatic conditions, monitoring irrigation through EWUIS is a mean of adaptation to climate change.
Technology characteristics/highlights	- Drip irrigation involves the delivery of water through a pipe distribution network under particular quantity and low pressure and works by applying water directly to the soil at low flow rates (0.22 to 0.45 GPH). - Micro-sprinkler irrigation refers to an irrigation system that applies water through small devices. Water is sprinkled, sprayed, or misted through emitters operating by throwing water through the air, usually in predetermined patterns. Depending on the water throw patterns, the micro-sprinklers are referred to as mini-sprays, micro-sprays, jets, or spinners. The sprinkler heads can be mounted on a support stake or connected to the supply pipe. They operate at low pressure and have a wide range of flow rates (5 to 50 GPH). - Both systems require: ✓ A pump which takes water from the source and provides pressure for delivery into the pipe system. Pressure may vary form 2-3 bars (drip) to more than 10 bars. ✓ Filters and eventually a fertilization mixer and a water reservoir ✓ Main pipes and secondary pipes which deliver water from the pump to the laterals. ✓ Drip emitters or mini-sprinklers and their variances ✓ Monitoring plant water need through tensiometers or through programs addressing irrigation quantity and frequency provided by technicians.
Institutional and organizational requirements	- EWUIS is applied at farm level. It usually involves use, management and maintenance by individual farmers. - Monitoring irrigation requires capacity building which involves: research institute (LARI weather stations), extension services (Ministry

	of Agriculture, NGOs…), cooperatives and farmers groups. - Organizational requirements could be needed through water user associations or "water committees" or Litani River Authority to organize water distribution and ensure the maintenance of the distribution system outside the farm gate, whenever the water source is collective.
Operation and maintenance	Operation and maintenance consist primarily of carefully cleaning drippers or tubing or nozzles in order to avoid leakage or plugging. Moreover, building workers capacities is required in order to accurately install the system, manage it and control water flow.
Endorsement by experts	EWUIS is growing worldwide. Drip and mini-sprinkler and their variances are tested on a wide range of crops grown under different climatic conditions and management practices. They are recommended by many experts and researchers around the world.
Adequacy for current climate	Fits well, both for present and expected climate.
Scale/Size of beneficiaries group	- Beneficiaries include fruit tree, vegetable, banana, grapevine and even potato growers, in areas with permanent or seasonal water scarcity. Drip and mini-sprinklers are not fit for cereals (wheat, barley, etc.) and forages. - It is recommended to avoid adopting drip irrigation in areas where there are problems of soil salinity. - Micro sprinklers suit all applications in the irrigation of seedlings and mature trees. They can be used in orchards, greenhouses, nurseries and in areas where drippers are not practical. - Mini-sprinkler system is particularly beneficial to avoid frost damage on crops. - Sprinklers will be only considered for supplementary irrigation for cereal growers.
Disadvantages	- High initial cost associated with the costs of system components. - Need of energy source for pumping and applying water under the required pressure. - The head unit and water reservoir require a minimum surface area that sometimes is not available in small holdings. - Reliance on a clean source of water and therefore may not be suited to areas where rainfall is becoming less predictable. - In some cases, implementation costs are higher than that of gravity-fed irrigation systems; however the later requires annual land preparation and plowing, which is not necessary in EWUIS. - Drip systems are also exposed to damage by rodents or other animals. - It can be difficult to combine drip irrigation with mechanized production as tractors and other farm machinery that can damage pipes, tubes or emitters; however special adjustments or arrangements could be conceived in such cases. - Implementation of mini-sprinklers is related to climatic conditions, water resources and cost. Even moderate winds can seriously reduce the effectiveness of sprinkler systems by altering the distribution pattern of the water droplets. Likewise, when operating under high

	temperatures, water can evaporate at a fast rate reducing the effectiveness of the irrigation.
Capital costs	
Cost to implement adaptation technology	- Initial cost includes the cost of the system including the head unit. This cost depends highly upon the size of the irrigated area, the topography, the specific type of technology, automatic devices, materials used, the quality of irrigation water as well as the amount of labor required. - The cost of installing a drip irrigation system ranges from 1000$ to 2500$/ha. - The cost of a micro-sprinkler irrigation system ranges from 1200$ to 3000$/ha. - Finally, the average life of EWUIS is around 10 years.
Additional cost to implement adaptation technology, compared to "business as usual"	Among the additional costs we mention: cost of designing the irrigation system, the energy (electricity/diesel to pressurize water), cost of the training to farmers on how to use this technology, and cost of monitoring irrigation. Nevertheless, if in ground water irrigation gravity is not enough, pumping would require more energy as more water is used for irrigation. The same figures are observed with sprinkler system. Note that land preparation for surface irrigation requires annually more labor, time and energy costs when compared to EWUIS, which makes the latter much cost-effective.
Long term cost (i.e. 10, 30, or 50 years) without adaptation	
Long term cost (i.e. 10, 30, or 50 years) with adaptation	
Development impacts, direct and indirect benefits	
Direct benefits	- EWUIS enables reducing the cost of the production by reducing the required labor for land preparation and irrigation in surface irrigation. This is currently the major benefit for farmers. - Saving water by improving water delivery efficiency: it is the primary motivator for the implementation of EWUIS, meaning more plant growth for less water. Drip irrigation could reach an overall efficiency of almost 80% compared to surface and sprinkler irrigation having respectively efficiencies around 50% and 70%. - Contributing to food security by increasing crop yields (reduction in fertilizers through injecting fertilizers to the system in a controlled manner "fertigation process") and increasing yields of rainfed crops when supplementary irrigation is applied. - Drip system increases resistance to fungal diseases since crop leaves are not watered and reduces of weed growth since the wetted area is limited. - Water savings resulting from EWUIS could be used to increase irrigated areas, thus increase yield and income.
Reduction of vulnerability to	Avoid over exploitation of water resources, reduce GHG emission through minimal pumping hours from a diesel pump and from fertilizers

climate change, indirect	use. In drip systems, herbicide application is also reduced.
Economic benefits, indirect Employment Growth & Investment	 Creation of jobs to provide training to farmers and to sell the technology for users; reduce labor needed for surface irrigation. Potential increase in investments in importing or producing locally irrigation systems. Reduce investments in maintaining traditional distribution systems and in weed control through plowing. Reduce investments in maintaining agriculture terraces damaged by flood irrigation. All these factors will improve growth.
Social benefits, indirect Income	 EWUIS can provide significant water, fertilizers, herbicides, energy and labor savings (especially in drip system) and yield increase (especially in supplementary irrigation). The cost of production is reduced and farmers' income is increased.
Environmental benefits, indirect	The improved water quality and the reduction of chemical use minimize soil and groundwater pollution.
Opportunities and Barriers	- EWUIS is a versatile technology that can be employed in conjunction with other adaptation measures such as supplemental irrigation and the multi-cropping and fertilizer management as well as conservation agriculture, etc. - Water savings increase the opportunities of better using water reserves for different purposes (domestic, agriculture use, etc.) - Barriers include lack of access to finance for purchasing the equipment, and the procurement of energy source. - A higher amount of initial investment involved than other systems. - Technical conditions such as soil clay presence, irregular rainfall or steep slopes can increase implementation and maintenance costs or affect system efficiency. - The yield of existing crops (fruit trees) irrigated by gravity or another open system can be affected by changing to drip system. - A low level of public awareness for the importance of sustainable water management and use, and the lack of technicians providing monitoring of water needs and irrigation programs to farmers. - Another barrier is the inadequacy of the traditional water committees as well as the periodic distribution system among collective users of a determined water source. Drip irrigation provides optimal benefits when applied on a daily basis. Nevertheless, in the current context some farmers get their water share every 2- 3 weeks.
Market potential	The technology has a market potential nationwide.
Status	Present in different areas in the country, but still not widely adopted. Only 25% of farmers have drip irrigation systems, yet, irrigation monitoring based on plant needs is absent.
Timeframe	Short to medium term.
Acceptability to local stakeholders	Easy to accept for all involved stakeholders. Yet, the adjustment of water shares and their period could be a problem if water users associations are not created and empowered to make the necessary adjustments.

[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/**