

2011

Water and Livelihoods Initiative (WLI)

Fourth Quarter Progress Report
(September – December 2011)



Acronyms

AUB: American University of Beirut, Lebanon

CLP: Community Livelihood Project

CU: Columbia University

DTM: Digital Terrain Model

FTF: Feed the Future

GCC: Global Climate Change

GIS: Geographic Information System

ICARDA: International Center for Agricultural Research in the Dry Areas

IDW: Inverse Distance Weighted

IWLMP: Integrated Water and Land Management Program

IWMI: International Water Management Institute

LARI: Lebanese Agricultural Research Institute

MENA: Middle East and North Africa

MEPI: Middle East Partnership Initiative

NARS: National Agricultural Research Systems

SWAT: Soil and Water Assessment Tool

UC-D: University of California–Davis, USA

UC-R: University of California-Riverside

UF: University of Florida, USA

UI-UC: University of Illinois at Urbana-Champaign, USA

UJ: University of Jordan

USAID: United States Agency for International Development

USDA-ARS: United States Department of Agriculture –Agricultural Research Service

USDA-FAS: United States Department of Agriculture/Foreign Agricultural Services

USU: Utah State University, USA

WANA: West Asia and North Africa

WLI: Water and Livelihoods Initiative

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Executive Summary

The fourth quarter of the year marks the end of the second year for WLI. Accomplishments in the year 2011 were presented at the Third Regional Coordination Meeting which was held on December 13-14, 2011 in Amman, Jordan. The meeting was attended by ICARDA's Director General – Dr. Mahmoud Solh, Dr. Scott Christiansen – a senior Agricultural Advisor from USAID, invited guests, and all of WLI's partners with the exception of IWMI and UC-Riverside. The meeting served as an excellent forum to appraise WLI's accomplishments in the year 2011, and to discuss the work plans for 2012. Participants of the meeting also benefited from various plenary presentations on a range of topics that are of relevance to the Initiative. The 4th Steering Committee Meeting was held on December 15, 2011 following the Regional Coordination Meeting. The Steering Committee which comprises of senior representatives of WLI partners, discussed the achievements, future directions, and challenges facing the Initiative.

Planned activities under the socio-economic and bio-physical components were carried out during the reporting period. Under the socio-economic component, the NARS (with the exception of Syria and Yemen) focused on data collection, entry and analysis. On the other hand, the bio-physical teams in Egypt, Jordan and Lebanon focused on modeling activities while those in Iraq, Palestine and Yemen worked towards developing suitability maps for their respective benchmark sites. The bio-physical team in Syria continued with their efforts to complete the characterization of their benchmark site.

The trend of looking-inward and using local expertise to provide targeted training to WLI team members also continued in this quarter. This was especially true in the case of Iraq and Egypt where members of the WLI team trained their colleagues and equipped them with essential skills required to conduct surveys and analyze data collected. A regional training to introduce WLI partners to the objectives of USAID's Feed the Future (FTF) Initiative was also offered during this time. The training, given by Drs. Sarah Tully and Clarissa Hageman from USAID and Dr. Sandra Russo from UF, allowed WLI partners to seek ways of aligning the FTF results framework to the benchmark indicators. It was attended by WLI partnering NARS and four participants from ICARDA's OASIS project.

The Student Exchange Program also continued in the reporting period. In Iraq a post-doc from the College of Agriculture (University of Baghdad) was recruited to study the "Effect of saline water and deficit irrigation on the growth and yield of sunflower" under the supervision of Dr. Ahmed Alfalahi from the WLI team, and Dr. Hadi Husham from University of Baghdad. In Syria, the WLI team has identified six research topics and has appointed graduate students to undertake each study. In Lebanon, Ms. Roula Bachour continued her research on water accounting of the Orontes Basin. Major challenges during the quarter related to the current political situation in the region. The challenge was most evident in Yemen and Syria which limited free mobility to implement planned activities.

Activities in the Quarter

Third WLI Regional Coordination Meeting

Among the highlights of events in the quarter is the Third WLI Regional Coordination Meeting which was held on December 13-14, 2011. The meeting was organized to appraise activities undertaken by the NARS during 2011, and to discuss the work plans for 2012. The meeting was attended by ICARDA's Director General Dr. Mahmud Solh, and representatives from USAID, partnering countries, US and Regional Universities, as well as scientists from ICARDA. The meeting also served as an excellent forum for invited guests from USDA-Agricultural Research Services (ARS) and USAID-Baghdad, to share their experiences with WLI partners.

The 4th Steering Committee Meeting was held on December 15, 2011 following the Regional Coordination Meeting. The Steering Committee appraised WLI's achievements in 2011 and discussed future directions for the Initiative. The Committee also endorsed the new *WLI-Middle East and North Africa (MENA) Platform for Partnership* proposal, which expands the geographic and technical scope of the Initiative.

A comprehensive report on the Regional Coordination Meeting, including the accomplishments of and challenges faced by WLI partners in the year 2011, will be submitted to the donor separately. Below is a brief summary of the presentations given by the guest speakers.

Dr. Charles Onstad is a retired USDA-ARS officer, who is contracted to conduct a thorough review of the WLI and identify future areas of focus that can be pursued within the existing budget limitations. Through his presentation on "WLI Perspectives", Dr. Onstad highlighted the importance of conducting a comprehensive project review and suggested a six-step strategy, namely: (1) Evaluate accountability, (2) Improve project design and implementation, (3) Evaluate performance, (4) Evaluate impact, (5) Evaluate potential for learning, and (6) Evaluate project management.

Dr. Floyd Horn presented on "Modern livestock disease diagnosis technologies of relevance to the WLI". His presentation underscored the (i) importance of livestock, (ii) disease challenges, and (iii) "Leap frog" technologies such as rapid diagnostics –which is a critical technology in disease detection and identification. Dr. Horn made preliminary suggestions to the WLI team, including measures to prevent catastrophic losses from animal disease in the livestock industry.

Dr. Donald Suarez, Director of the US Laboratory at USDA-ARS, presented on "Salinity Research of Relevance to the WLI and Potential Collaboration between ARS and the WLI for Capacity Development". The presentation offered a good insight into research activities at the U.S. Salinity Laboratory/Riverside. His presentation focused on (i) water reuse and remediation which are useful to predict the impact of degraded and saline waters on infiltration and plant

response to degraded waters under different climatic conditions, and (ii) contaminant fate and transport to improve models and develop management strategies to re-use degraded waters. Dr. Suarez also highlighted the state of plant research at the Laboratory, which seeks to (i) identify variability in physiological and biochemical responses to application of saline waters, (ii) develop strategies to mitigate negative effects of salts and toxic ions, and (ii) identify genetic markers for traits associated with physiological salt stress response that can be used to develop germplasm with improved salt tolerance.

Dr John M. Schnittker from USDA- Foreign Agricultural Services (FAS) Baghdad – Iraq, presented on USDA’s role in Iraqi Agriculture. He elaborated on USDA/FAS’ plan of work as it relates to (i) trade policy, (ii) market development, (iii) data and analysis, (iv) international development, and (v) efforts to develop agricultural systems in developing countries. His presentation also shed light on the state of Iraq’s agricultural sector and USDA’s ongoing efforts to work with USAID’s Bureau of Humanitarian Assistance.

Dr. Simon Sala from Columbia University (CU)/Center for International Conflict Resolution, presented on potential areas of collaboration between WLI and CU. He elaborated on the University’s current efforts to enhance the technical and practical experiences of its students by partnering with International Non-Governmental Organizations (INGOs). In the case of WLI, he proposed that students from CU conduct research at WLI benchmark sites on topics that are of relevance to both WLI and CU, such as “Potential Areas of Conflict in Water Management”. Dr. Sala explained that the cost of the research will be shared between CU and WLI, where WLI will be responsible for the transportation and in-country logistics support; and CU will cover the student’s living expenses.

Activities at the Benchmark Sites

Egypt

Bio-physical component: The team continued with their efforts to prepare the area selected for modeling water productivity and irrigation sustainability. The area, located in the Old Land near Damanhour city, was equipped with two accumulative pump operating-time measuring devices and an automatic water level recorder. The team also designed a questionnaire to investigate the effects of agricultural practices on soil compaction, and to assess the perception of farmers on the consequences of soil compaction on water management and agricultural productivity. The questionnaire will also be useful to establish a database on: (i) cropping practices in the area including crop patterns, specific crop needs, rotation, yields, fertilizers, irrigation and drainage; (ii) machinery and mechanical applications including tire size and pressure, axle loads, coverage, number of passes, slippage; and (iii) operational economics including cost of adopting different

agricultural practices in terms of their effects on yield, the environment, and soil conservation efforts. The data collected will be analyzed using Geographic Information System (GIS) tools required to develop integrated sustainability index of water and soil management for irrigated agriculture.

The survey is expected to cover 50-100 points representing the average conditions of the Tertiary Canal Zone. The information collected through the survey will be supplemented by additional information gathered through field measurements at various intervals, specifically (i) in the middle of the winter season, (ii) end of the winter season, (iii) after harvesting of the winter season (bare soil), (iv) at the start of summer season, (v) in the middle of summer season, and (vi) at the end of summer season. The survey is expected to begin sometime in January 2012.

Socio-economic component: Following the training on “Socio-Economic Survey” which was conducted in the previous quarter (September 11-15, 2011), the team proceeded with the data collection process covering the three villages of El Zankalon, El Hussinia and El Bustan. The survey is based on a sample size of 150 farmers (out of which 25 are women) from each of the three sites.

Iraq

Bio-physical component: During the reporting period, the team analyzed the data collected in the second quarter of the year from 500 farmers and 50 users of the greenhouse technology. The analysis revealed that sowing on furrows and plots using surface irrigation was the most dominant cultural practice at the benchmark site - representing 97% of total area cultivated. The data was also used to identify key indicators for water productivity within the context of agricultural production systems in the area. Suitability map for the irrigated area was also developed in the fourth quarter, and the team will continue to collaborate with other WLI partners to finalize the suitability criteria for irrigated agro-ecosystems.

Socio-economic component: During the reporting period, the team concluded their data collection and entry process on various variables including contribution of agriculture to household income, total area cultivated, tenure system, cropping systems, cost of inputs, constraints to livestock production, and the role of women in the agricultural sector. The data was analyzed and preliminary results were shared with the WLI partners at the *Third Regional Coordination Meeting*. The team had also planned to conduct an in-country training on gender analysis but was not able to find an expert in the field to train the selected individuals. The team has thus requested ICARDA’s help to organize such a training.

Jordan

Bio-physical component: During the reporting period, the team continued its efforts to collect data on soil, wind, temperature, rainfall, siltation, and other parameters required for Soil and

Water Assessment Tool (SWAT) modeling. Soil samples from weirs and geo-textiles sites in the benchmark site of Majidiah were analyzed during this period. The process is expected to continue for the next two years. Moreover, the team worked on the two water harvesting demonstration sites (Al Mafrag and Mhareb - about 10 hectares each) selected in the last quarter. Contour ridges are now developed and the land is prepared for Atriplex and Salsola shrubs which will be planted in January 2012. Another demonstration site on Mhareb was planted with barley.

Socio-economic component: The team received provisional approval of the USAID Middle East Partnership Initiative (MEPI) concept proposal it had submitted to the American Embassy in Amman. The proposal aims to expand the scope of activities at the Majidiah and Mharib cooperatives, while developing the capacity of the Ngera cooperative to train members of other cooperatives. The team also continued its efforts to conduct the gender survey, which was pre-tested among the local communities at Mahareb and Majedia in the third quarter.

Lebanon

Bio-physical component: In line with their 2011 plan to complete the soil, water, land and climate characterization in Hermel and Al-Qaa sites, the team analyzed data collected on soil, water and agricultural practices. The data was supplemented by information gathered through interviews with farmers, government officials, and extension agents. The physio-chemical analysis of the soil samples looked at the percentage shares of fine sand, coarse sand, fine silt, coarse silt, clay content, organic Matter, pH, electrical conductivity (ds/m), total CaCO₃, and active Ca. Other properties considered include N (kg/ha), Phosphorus (ppm), Potassium (ppm), Sodium (ppm), Sodium Adsorption Ratio, Magnesium (ppm), available calcium (ppm), and Iron (ppm).

Water sample collected from 90 different locations (wells and open water channels) were also analyzed for electrical conductivity (ms/cm), sum of minerals (g/l), pH, Ca⁺⁺ (mg/l), Mg⁺⁺ (mg/l), K⁺ (mg/l), Na⁺ (mg/l), Fe⁺⁺⁺ (mg/l), sum of cations (mg/l), bicarbonate HCO₃⁻ (mg/l), chloride Cl⁻ (mg/l), NO₃⁻ (mg/l), SO₂[—](mg/l), sum of anions (mg/l), and number of coliforms/100ml. The analyses revealed that the total coliforms content is higher in water wells around the village of “El Qaa”. Accumulation of Nitrogen was also observed in wells close to the cultivated portion of the benchmark site.

Digitalizing of field parcels as GIS layers which began in the third quarter was completed in the reporting period. The exercise revealed that cultivated fields were very small with fields less than 1 ha representing 64% of total number of cultivated area; and 29% of the fields representing cultivated areas that are greater than 2 ha but less than 5ha (Figure 1).

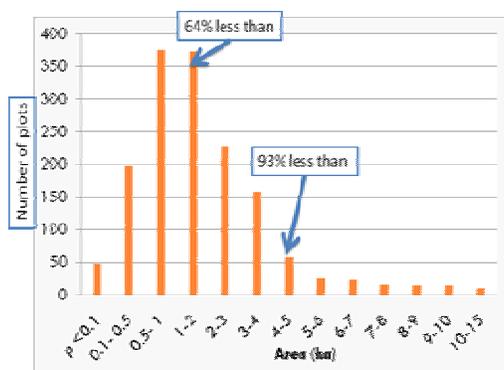


Figure 1: Sizes of cultivated fields in the benchmark area

Socio-economic component: Data collection which began in the previous quarter in El Qaa region (Baayoun, El Benjachie, Wadi El Khanazir, and Jouar Mequiyeh) was completed in the reporting period. The team hopes to analyze the data with the help of Dr. Samia Akroosh from NCARE/Jordan who is scheduled to visit the Lebanon Agricultural Research Institute (LARI) in January 2012.

Palestine

Bio-physical component: the team focused on developing a suitability map for the Hebron benchmark site. The team adopted the Jordanian classification system for land suitability mapping (Annex I) and the “Guidelines for Selecting Water Harvesting Techniques in Drier Environments” (Annex II), with some modifications to account for conditions that are unique to Palestine, to develop water harvesting suitability map. The data collected from the soil samples taken in the last quarter were complimented with “limitation criteria” developed through the following procedures.

- Created a DTM (Digital Terrain Model) for the benchmark using 5 meters intervals contour file, in order to create a slope grid map,
- Reclassified the slope map to fit the slope criteria classes,
- Converted the slope grid to a shape file,
- Appended the slope class to each soil observation according to the observation location,
- Created a rainfall grid map from weather stations historical data, and reclassified it to fit the rainfall criteria classes, and
- Converted the classified rainfall grid to a shape file, and appended the rainfall value for each soil observation.

The team used similar procedures to establish a database on soil texture, depth, calcium carbonate, erosion, rockiness, stoniness, and accessibility. The database, in combination with the dataset collected through soil observations, was used to develop raster maps using the Inverse

Distance Weighted (IDW) interpolation method. Each limitation criteria thus has a raster map that can be converted into a shape file, and be compared with its corresponding limitation criteria to develop a suitability map. Please refer to Annex III for detailed information on the Model adopted by the team to develop Land Suitability for Rangeland and Water Harvesting. Suitability map for the Tammun site was not developed as planned due to lack of essential data and budget constraints.

Socio-economic component: the team mainly focused on analyzing the data collected from over 171 households from both benchmark sites. A local consultant, Mr. Ameen Abu Saoud, was hired to help the team with the analysis. Preliminary results of the analysis identified the following challenges that were faced by the community, which were used as a basis for the team's plan for 2012.

- Water scarcity due to low annual rainfall (70-300 mm) and man-made problems,
- High cost of water (US\$/m³),
- Lack of rangeland management (43% of the benchmark area),
- Low profitability in rainfed cropping systems (95% of the surveyed households), and
- Unemployment,
- Lack of access to loans and credit services,
- Lack of agro-processing and post-harvest services,
- Lack of access to veterinary services and livestock production support,
- Lack of technical support for the farmers, and
- Israeli aggression and closure.

Moreover, the team reported that the WLI is gaining acceptance among the community in the benchmark sites.

Syria

Bio-physical Component: As part of its effort to complete the bio-physical characterization of the benchmark site, the team focused on digitalizing maps, cotton bio-fertilization at Al Gab site, and analyzing plant, soil, and water samples. The analyses resulted in a paper that was published by the American-Eurasian Journal of Agricultural and Environmental Sciences (Adlah, W. A. Arslan, and A. Khorshid. 2011. "Effect of Organic and Mineral Nitrogen Fertilization on the Production Components of Cotton (strain 124) Under Al-Ghab Conditions." *American-Eurasian Journal of Agricultural and Environmental Sciences*. 11(4):534-541, 2011).

Socio-economic Component: Planned data collection through field surveys was not possible due to security concerns in the area.

Yemen

Bio-physical component: the team mainly focused on updating existing bio-physical database on the Abyan Delta by reviewing existing data and interpreting results of the soil and water

analysis conducted in previous quarters. The database was used to generate suitability maps for soil, land and salinity of water.

Socio-economic component: Planned activities were not carried out during the reporting period due to security concerns at the Abyan Delta benchmark site.

Training

Feed the Future - Monitoring and Evaluation Workshop (December 15, 2011): A one-day training on Monitoring and Evaluation was offered to WLI's national partners and four representatives from ICARDA's OASIS project. The training was given by Drs. Sarah Tully and Clarissa Hageman from USAID and Dr. Sandra Russo from the University of Florida. The training introduced the NARS to the objectives of USAID's Feed the Future (FTF) Initiative, sought ways to align the FTF results framework to the benchmark indicators, and discussed the mechanisms to select appropriate indicators and collect data required. The teams are now in the process of developing the frameworks.



Conducting Socio-Economic Analysis (November 13-15, 2011): A three-day training was conducted by the Iraq team on data collection, analysis and reporting. The training was attended by five participants from the WLI team.

Determination of Crop-Water Requirement (October 6-9, 2011): In-country training on determination of crop-water requirement was conducted by the WLI Iraq team at the Training and Rehabilitation Center of Abu-Ghraib. The training was attended by 10 participants from different Agricultural offices operating in the area.



Conducting Soil Compaction Survey (November 9 and 26, 2011): Training on "Conducting Soil Compaction Surveys" was given by the WLI team in Egypt to selected enumerators. The training was offered prior to conducting the bio-physical survey in order to guarantee the quality and reliability of the data to be collected. The training was followed by several meetings in December to continue the discussion on soil degradation (soil compaction and salinity build-up),

and various factors that can contribute to the problem- including chemical use, irrigation practices, salinity, etc.

Student Exchange Program

Iraq: the Iraq team recruited a post-doc from the College of Agriculture (University of Baghdad) to study the “Effect of saline water and deficit irrigation on the growth and yield of sunflower” under the supervision of Dr. Ahmed Alfalahi from the WLI team, and Dr. Hadi Husham from University of Baghdad. The student considered three levels of saline water (fresh, 4 dS.m⁻¹ and 6dS.m⁻¹) with 4 treatment of stopping the irrigation (without stopping, stopping green growth, flowering, and seed filling). The student is now conducting his final analysis and will report his findings upon the completion of the research.



Lebanon: Ms. Roula Bachour, a PhD student in civil and environmental engineering from Utah State University, is now back in Lebanon to continue her research that she began in the summer of 2011. Under the supervision of Dr. Mac Mckee, Ms. Bachour will evaluate available data on water resources, irrigation practices, and system operation with the aim of developing a long-term plan for applied water-related research at the Orontes benchmark site. The research is expected to be completed by 2015.

Palestine: A local graduate student (MSc) is conducting research on ‘Assessing the Efficiency of Existing Rainwater Harvesting Techniques & their Usage for Agriculture’ using GIS and Remote Sensing technologies for the water catchment areas in the Southern Benchmark.

Syria: The student exchange program did not materialize as planned in Syria due to security concerns. However, the WLI team has identified the following local graduate students who are now in the early stages of developing their respective research outlines. Below is the list of students and the proposed title of their research.

1. Tammam Yaghi, “Water accounting of the area between the Lebanese border and Al Rastan dam”
2. Ammar Abas, “Water accounting of the area between Al Rastan dam and the Turkish border”
3. Darin Assad, “Water on deficit irrigation of Corn”
4. Mohammad Shibli, “Water on the effect of regular and irregular deficit irrigation on growth, and yield of soya bean using drip irrigation”

5. A PhD proposal to conduct analytical research that explores ways of improving export efficiency of some agricultural products (plant and animal) and their impacts on farmers income at Al Gab region is underway. The proposal, prepared by Eng. Shadia Awad, was presented to ICARDA and is being revised to reflect the comments and suggestions given by the the ICARDA team.
6. Another proposal to conduct an “Analytical study of the economic and social impact of adopting modern irrigation techniques in Al Gab” is also being developed. However, actual execution of the research will be delayed because of security concerns in the area.

Exchanges and Visits

Samuel Ribnick is a Fulbright Fellow who joined the WLI/Jordan team in October 2011, to develop a proposal on how to promote the adoption of the Valerani package among local communities in Jordan. Samuel will (i) study the traditional practices of grazing and land management in the area to identify potential entry points to introduce the Valerani package, and ensure its successful implementation, and (ii) explore the possibilities of scaling up the technology to reach other areas that share similar cultural practices and challenges in land management.

Dr. Charles Onstad: visited the benchmark sites in Egypt during the reporting period to assess WLI activities and make recommendations for future directions that can be pursued given the resource limitations. Dr. Onstad also participated in WLI’s 3rd Regional Coordination Meeting where he presented his plans for a thorough assessment of the Initiative. Dr. Onstad will continue his visits to and assessment of other WLI benchmark sites and submit a final report at the end of his evaluation.

Fund Raising Efforts

The following are brief summaries of efforts made to mobilize funds in the reporting period.

Global Climate Change (GCC) adaptation proposal (Nov) – not competitive: Responding to an internal call for proposals from the USAID Climate Change team, staff at USAID and ICARDA prepared a concept note for consideration by the panel. Unfortunately, the proposal did not make the short-list as there were 50 other proposals submitted globally for the six final awards that will be granted.

Iraq Agriculture Project Design (Oct-Dec) – potential link with WLI: Dr. Scott Christiansen visited Iraq twice in 2011 to work with the USAID/Baghdad mission on a design of a new agriculture project that has relevance to the WLI. USAID officials attended the Annual

Coordination and Planning Meeting in Amman on 13 Dec 2011 to meet with ICARDA management and will have follow up discussions on January 6, 2012.

Yemen Community Livelihoods Project (CLP) & MEAS (Dec) – potential link with WLI:

It is too early to tell how the WLI and MEAS might interact with the CLP in Yemen but discussions have been taking place since November with colleagues in the Mission and at Creative Associates who are implementing CLP.

WLI-MENA: A Platform for Partnership to Enhance Food Security: A proposal was developed during the reporting period to broaden the donor base of the WLI. The proposal also expands the geographic and technical scope of the Initiative by including North Africa and by adopting an overarching goal of enhancing food security. The proposal was discussed at the Third Regional Coordination Meeting held on December 13-14, 2011 and was endorsed by members of the Steering Committee at the Fourth Steering Committee Meeting held on December 15, 2011.

Upcoming Events

Preparations are underway to organize a workshop in Beirut (Lebanon) on “**Improving Food Security through Adoption of Appropriate Land and Water Policies**”. The workshop seeks to appraise policy options and implementation strategies that have significant potential in maintaining or enhancing land and water management, food security and livelihoods in a sustainable and economically viable way. The workshop will also promote partnership among disciplines and organizations working on land and water policies, food security and rural livelihoods in the WANA region. The workshop is tentatively scheduled for March 26-27, 2012 and will primarily target national partners working under the OASIS and WLI projects, as well as representatives from the Ministries of Economic or Rural Development in the MENA region.

Training on “**Scientific Writing, Reporting and Presenting Outcomes**” is being organized by the Integrated Water and Land Management Program (IWLMP) at ICARDA. The training targets all NARS working with the Program, including WLI team members responsible for writing periodic reports and presenting WLI’s work at various forums. The training is expected to develop the NARS’ communication skills by equipping them with the essential skills required to produce high quality reports. The training is tentatively scheduled for February 2012.

Annex I: Classification System for Land Suitability Mapping

Land Quality / Land Characteristics	Unit	S1	S2	S3	NS
<i>Climate (c) Mean Annual Rainfall</i>	mm	>340	320-340	300-320	<300
<i>Soil Texture</i>	Class	1 C	2 CL+L	3 ZC	4 ZCL
<i>Soil Depth</i>	Cm	>100	50-100	20-50	<20
<i>Calcium Carbonate</i>	%	<40	NL		
<i>Erosion1 (e) Erosion Hazard 2=Rill or 3=Gully</i>	Class	1 (nil)	2 (slight)	3 (mod)	4 (severe)
<i>Erosion2 Hazard 1=Sheet 4=Wind 5=Undifferentiated</i>	Class	2 (slight)	3 (mod)	4 (severe)	
<i>Topography (t) Slope</i>	%	<4	4-12	12-25	>25
<i>Rockiness (r) Rock Outcrop</i>	%	<20	20-40	40-60	
<i>Stone at the surface</i>	%	<10	10-25	25-40	>40
<i>Accessibility – for future intervention</i>	Class	1 A+B	2 C	3 CMP	4 BW

Note:

Soil texture:

C: Clay , CL: Clay Loam , L: Loam , ZC: Sandy Clay , ZCL: Sandy Clay Loam

Accessibility: A: Area A , B: Area B , C: Area C , CMP: Colony Master Plan BW: Behind the Wall

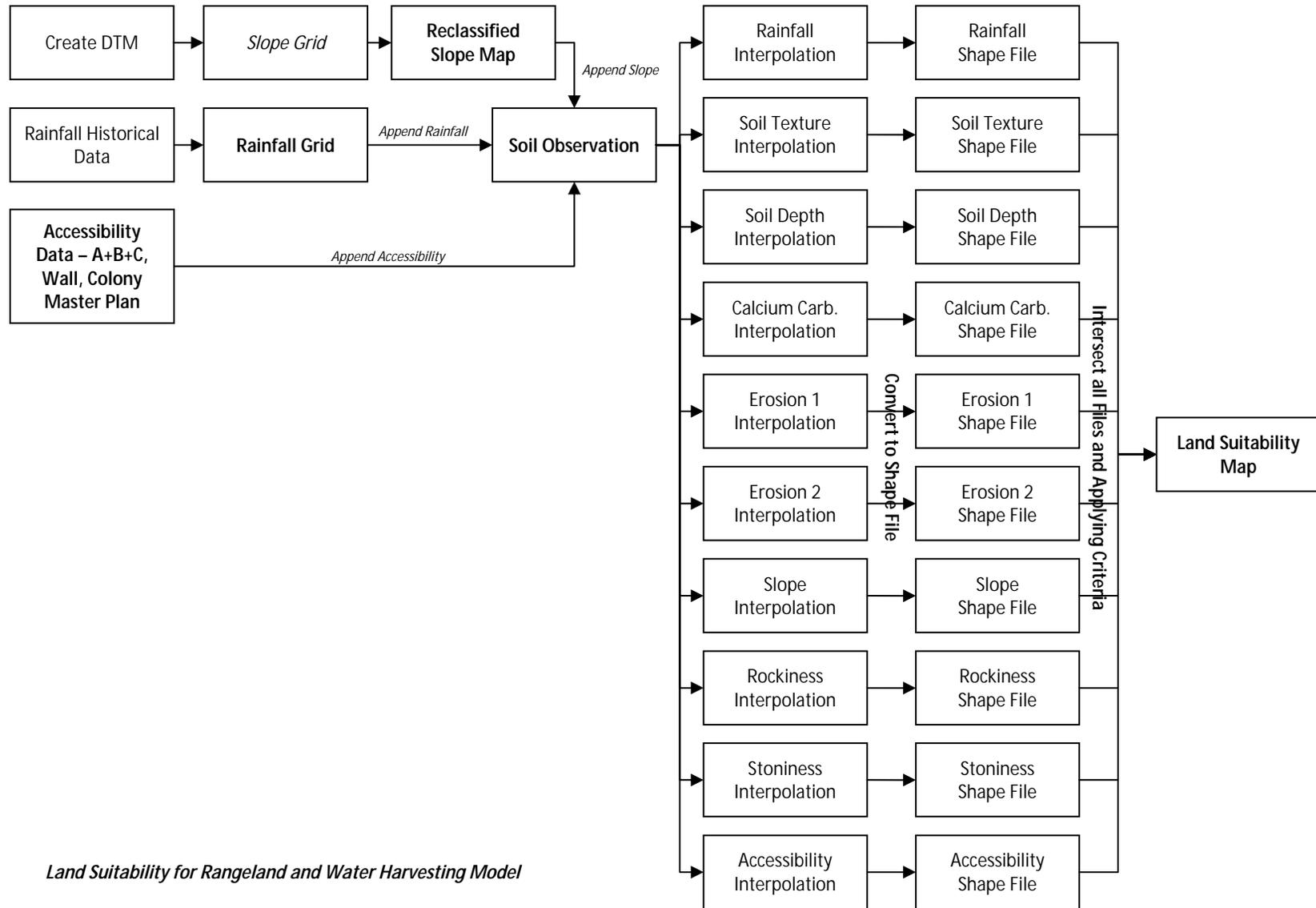
Annex II: Guidelines for Selecting Water Harvesting Techniques

Table 1: Modified Guidelines for Selecting Water – Harvesting Techniques

Technique	Crop	Soil				Land		Land Cover				Socio-economic	
		Depth (1)		Texture		Slope (2)		Vegetation (3)		Stoniness (4)		Farm Size (5)	
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Micro-catchments													
On-farm systems													
Contour ridges	Range	shl	med	med	var	med	steep	poor	med	med	low	var	var
	Field	med	deep	med	var	low	med	poor	poor	low	low	med	med
Semi-circular and triangular bunds	Range	shl	med	var	var	med	low	poor	med	med	low	var	var
	Field	med	deep	med	heavy	low	med	poor	poor	low	low	med	med
Small basins	Trees	deep	deep	heavy	med	low	low	poor	med	low	med	med	med
Runoff strips	Range	med	var	med	var	med	low	poor	med	med	var	med	var
	Field	deep	med	med	med	low	med	poor	poor	low	med	med	med
Inter-row system	Trees	deep	deep	heavy	med	low	low	poor	med	low	med	med	med
Contour bench terraces	Trees	deep	med	heavy	heavy	steep	med	poor	med	low	med	med	med
	Field	deep	med	heavy	var	steep	med	poor	poor	low	med	med	med
Narrow-base Contour terraces (Gradoni)	Trees	deep	deep	med	heavy	steep	med	poor	med	low	low	med	med
	Range	deep	med	med	var	med	steep	med	low	low	med	med	var
Macro-catchments													
Wadi-bed systems													
Meskat and Trapezoidal bunds (Cultivated area)	Trees	deep	med	med	heavy	low	low	poor	med	med	low	med	large
	Field	med	med	heavy	med	low	med	poor	poor	low	med	med	med
Catchment area	-	shl	var	var	heavy	med	steep	poor	poor	low	med	large	med
Wadi – bed cultivation (Water spreading)	All crops	deep	med	med	heavy	low	low	low	med	var	var	med	med
Jessour	Trees	med	var	heavy	med	med	steep	var	med	med	var	med	med
Off – wadi systems													
Water spreading (diversion)	Field	med	deep	med	heavy	low	med	poor	med	low	med	med	var
	Trees	deep	med	med	heavy	low	low	poor	poor	med	low	med	med
Large bunds	Trees	deep	deep	heavy	med	low	low	poor	var	med	low	med	large
	Field	med	var	med	var	low	low	poor	poor	low	med	med	med
	Range	med	var	var	var	med	low	var	poor	var	var	med	large
Hillside runoff systems (cultivated)	Field	med	med	med	var	low	med	poor	med	low	var	med	var
	Trees	deep	med	med	heavy	low	med	poor	med	low	var	med	med
Catchment	-	shl	var	var	heavy	steep	med	poor	poor	low	med	large	med
Tanks and Hafirs	All crops	Variable		med	heavy	low	var	poor	med	variable		med	var
Cisterns	-	shl	med	variable		variable		poor	med	variable		med	med

(1) shl <50 cm, med: 50-100 cm, deep> 100 cm, (2) low <4%, med: 4-12%, steep > 12%, (3) poor <15%, med: 15-30%, dense > 30%, (4) low < 10%, med: 10-25%, high > 25%, (5) med < 5 ha, med: 5-25 ha, large > 25 ha

Annex III: Land Suitability for Rangeland and Water Harvesting Model



Land Suitability for Rangeland and Water Harvesting Model

Annex IV: WLI Contact Information

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Annex IV: WLI Contact Information (Continued...)

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Annex IV: WLI Contact Information (Continued...)

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Dr. Sandra L. Russo	UF	Member
Dr. Francois Molle	IWMI	Member
Dr. Nahla Mohamed Zaki	Director of Water Management Research Institute, National Water Research Center, Egypt	Member
Dr. Hamdy Khalifa	Director, Soil, Water and Environment Research Institute, Agriculture Research Center, Egypt	Member
Prof. Bassem Ashour	Egypt	Member
Dr. Ahmed Adnan Ahmed Alfalahi	SBAR, Iraq	Member
Dr. Omar M. Kafawin	University of Jordan	Member
Dr. Yasser Mohawesh	NCARE, Jordan	Member
Ms. Randa Massaad	LARI, Lebanon	Member
Dr. Nasser Sholi	NARC, Palestine	Member
Dr. Awadis B. Arslan	GCSAR, Syria	Member
Dr. Khader Balem Atroosh	AREA, Yemen	Member