Food and Agriculture Organization
of the United Nations

DIGITAL APPLICATION FOR IRRIGATION ASSET MANAGEMENT

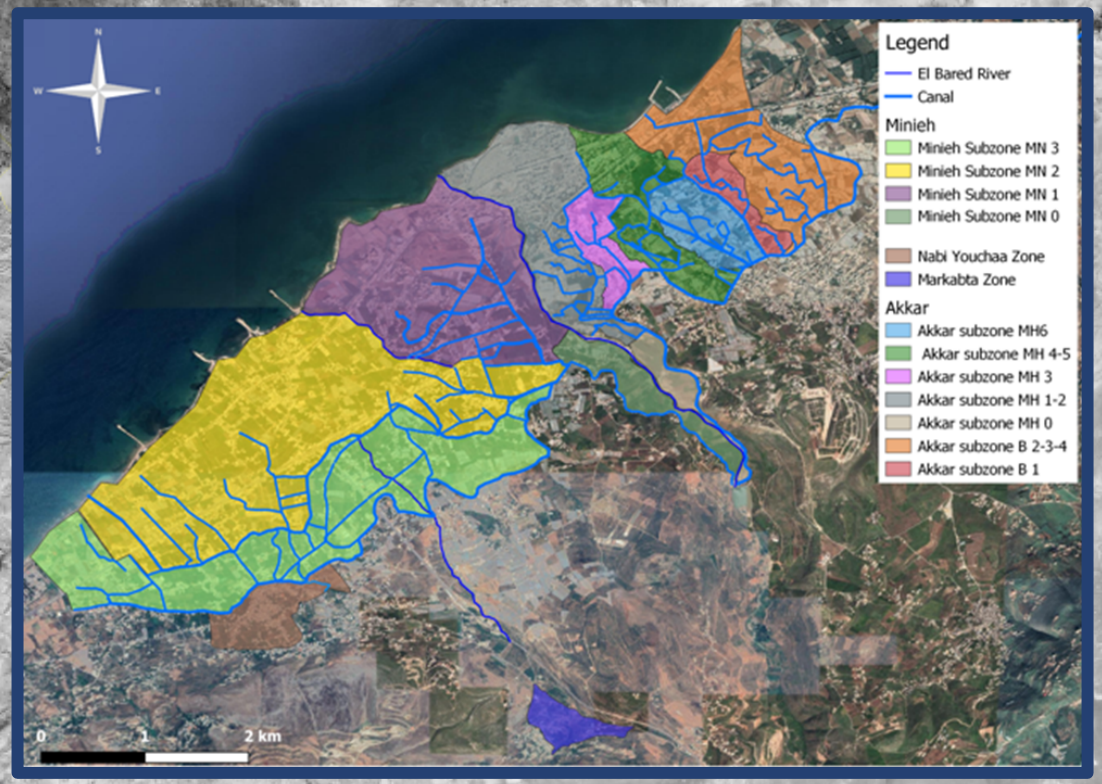
Camilla Simongini
Land and Water Division (NSL), FAO

Tunis, 13 December 2022

Regional gathering
Tunis, 12 – 16 December 2022

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

THE PILOT AREA

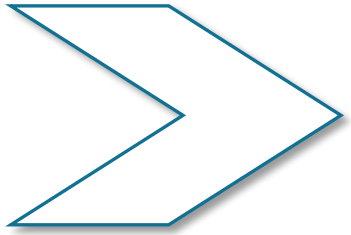


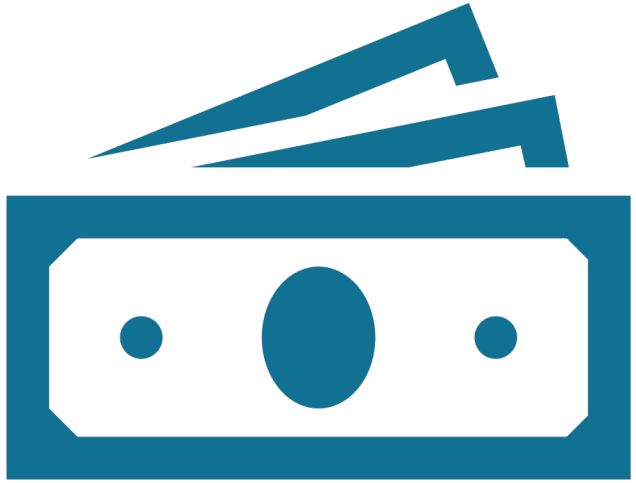
Source: Google Earth Pro v7.3.3.7786 (2022). Lebanon. 34°29'30 N, 35°58'33 E. United Nations, modified by the author. The boundaries and names shown and the designations used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Baseline conditions

Restored default condition

CONDITION-BASED ASSET MANAGEMENT





Local context	Design requirement
Peri-urban scheme	Manually conducted data-collection
Current condition of infrastructure	Restore baseline
Uncertainties around fee collection	Matched financial and human resources
Absent inventory	Disaggregated (asset-based) assessment
Social sensitivity to aerial technologies	In-situ assessment
Manually operated infrastructure	Observation-based assessment

Local context	Design requirement
Peri-urban scheme	Manually conducted data-collection
Current condition of infrastructure	Restore baseline
Uncertainties around fee collection	Matched financial and human resources
Absent inventory	Disaggregated (asset-based) assessment
Social sensitivity to aerial technologies	In-situ assessment
Manually operated infrastructure	Observation-based assessment

DESIGN OF FRAMEWORK

- Inventory-based O&M protocol
- Assessment of condition and criticality
- Financing assets

Inventory-based O&M protocol

Asset ID: type, location, installation date, responsible person, users, etc.

Definition of he purpose and function of the asset

Guidelines on manufacturer/expert recommendations for optimal operation and necessary maintenance works and inspection checklist

Instructions for inventory: frequency, timing, data collection template, data delivery, information storing, etc.

Food and Agriculture Organization of the United Nations

Swiss Agency for Development and Cooperation SDC

ASSET MANAGEMENT

Field training

Training manual

September 2021

FAO LEBANON

Food and Agriculture Organization of the United Nations

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Asset ID: type, location, installation date, responsible person, users, etc.

Definition of he purpose and function of the asset

Guidelines on manufacturer/expert recommendations on intentional operation and necessary maintenance works and inspection checklist

Instructions for inventory: frequency, timing, data collection template, data delivery, information storing, etc.

Assessment of condition and criticality

LEVEL LOGGER

Recommendations:

- **Frequency**: asset inspection is recommended at least 6 months frequency, or anytime when unprecedent event occurs
- **Required time to conduct scoring**: 10 minutes
- **Reporting line**: asset inspection requires field visit by site technicians. Scoring is to be reported to head office
- **Procedure:** Field technician perform asset inspection and scoring as per [illegible] O&M Manual. Scores are reported to the head office [illegible] photographic evidence. Radar chart is generated [illegible]
- **Baseline**: original master plans, condition in date of acquisition, international design standard
- **Supporting documents**: O&M Manual - datalogger

1. Condition score:

Dimensions	1. General maintenance level of logger	2. General maintenance level of wellhead	3. General maintenance level of auxiliary	4. General maintenance level of surrounding canal section	5. General maintenance level of surrounding environment
5 – Very poor	There is an evident sign that the logger is damaged (i.e. noises in the pipe, tilted structure, some large object fallen on the structure, etc.), needs immediate repair/replacement.	Critically damaged wellhead, the house is broken, and the wellhead is clearly affected, most probably it does not work, needs immediate repair/replacement.	Critically damaged auxiliaries (i.e. the cables visibly damaged and disconnected, the perforated pipe broken, houses broken or replaced, gauge broken etc.) which affect the operation, urgent repair or replacement is required.	Critically damaged canal section with major water loss, heavy sedimentation around the asset, potentially affecting the flow measurements, immediate intervention is required.	Critical decline in environment condition (i.e. heavy solid waste load, dense aquatic plants everywhere in the canal, other waste or large objects surround the asset), which is harmful for the datalogger, severely contaminated water, immediate intervention is required.
4- Poor	No evidence of proper maintenance, damages are visible, contamination is harmful, but the logger seems to be in place and condition can be partially restored.	No evidence of proper maintenance, wellhead is damaged, but still in place and condition can be partially restored.	No evidence of proper maintenance, i.e. perforated pipe is silted and its foundation is loose (i.e. rotating), which affects the operation, housing and cabinet are damaged, gauge scale is [illegible] functional.	Deteriorated canal section with major water loss and sedimentation, which affects the asset and potentially the flow measurements.	Damaging condition have immediate and long-standing, maintenance is required to avoid long-term effect. The datalogger condition is under risk of long-term exposure, the water contamination is severe (i.e. solid waste clogging, dense aquatic plants around the structure, rapidly deteriorating canal condition etc.).
3 - Moderate	The logger seems to be suffering from minor damages (i.e. sign of attempted [illegible] but still in place and condition can be restored.	Well-head is maintained, some minor damages are visible (i.e. attempt to break the house). The wellhead is in place and condition can be restored.	Moderately deteriorated parts, but auxiliaries are still functional, i.e. perforated pipe needs maintenance and cleaning, cables are slightly loose, housing and cabinet are damaged, gauge scale needs cleaning.	Moderately deteriorated canal, leakages are observable both in the bed and on banks, sediment deposit and flow measurements are not potentially affected.	Moderate condition (i.e. datalogger is surrounded by weed or aquatic plants in distant areas, foundation becomes instable due to canal deterioration etc.), water contamination is visible but not critical, environment degradation may have long-term effect.
2 - Good	No sign of damage or defect, minor signs of contamination that does not affect the operation, the logger is in place and condition can be certainly restored.	No sign of damage or defect, wellhead is well-maintained, some cleaning issues occur (i.e. water leaking into the house, etc.). The wellhead is in place and condition can be certainly restored.	No visible sign of damage or defect, auxiliaries are well-maintained, minor signs of maintenance issues, i.e. perforated pipe is slightly contaminated, cables need to be reinforced, housing and cabinet with lockers are undamaged, gauge scale is slightly contaminated.	Good condition, some leakage is observed, but it does not affect the asset performance and thus the flow measurements.	Good condition, some environmental issue (i.e. algae infestation, etc.) occur, but may not be harmful in long-term, water is clean.

LEVEL LOGGER

Recommendations:

- **Frequency**: asset inspection is recommended at least 6 months frequency, or anytime when unprecedent event occurs
- **Required time to conduct scoring**: 10 minutes
- **Reporting line**: asset inspection requires field visit by site technicians. Scoring is to be reported to head office
- **Procedure:** Field technician perform asset inspection and assign the condition scores by using the Inspection form included in the O&M Manual. Scores are reported to the head office and transferred to the PMS - Asset Management module together with photographic evidence. Radar chart is generated. Chart and scoring are saved and stored on the system
- **Baseline**: original master plans, condition in date of acquisition, international design standard
- **Supporting documents**: O&M Manual - datalogger

1. Condition score:

Dimensions	1. General maintenance level of logger	2. General maintenance level of wellhead	3. General maintenance level of auxiliary	4. General maintenance level of surrounding canal section	5. General maintenance level of surrounding environment
5 - Very poor	There is an evident sign that the logger is damaged (i.e. noises in the pipe, tilted structure, some large object fallen on the structure, etc.), needs immediate repair/replacement.	Critically damaged wellhead, the house is broken, and the wellhead is clearly affected, most probably it does not work, needs immediate repair/replacement.	Critically damaged auxiliaries (i.e. the cables visibly damaged and disconnected, the perforated pipe broken, houses broken or replaced, gauge broken etc.) which affect the operation, urgent repair or replacement is required.	Critically damaged canal section with major water loss, heavy sedimentation around the asset, potentially affecting the flow measurements, immediate intervention is required.	Critical decline in environment condition (i.e. heavy solid waste load, dense aquatic plants everywhere in the canal, other waste or large objects surround the asset), which is harmful for the datalogger, severely contaminated water, immediate intervention is required.
4- Poor	No evidence of proper maintenance, damages are visible, contamination is harmful, but the logger seems to be in place and condition can be partially restored.	No evidence of proper maintenance, wellhead is damaged, but still in place and condition can be partially restored.	No evidence of proper maintenance, i.e. perforated pipe is silted and its foundation is loose (i.e. rotating), which affects the operation, housing and cabinet are damaged, gauge is not functional.	Deteriorated canal section with major water loss and sedimentation, which affects the asset and potentially the flow measurements.	Damaging condition have immediate and long-standing, maintenance is required to avoid long-term effect. The datalogger condition is under risk of long-term exposure, the water contamination is severe (i.e. solid waste clogging, dense aquatic plants around the structure, rapidly deteriorating canal condition etc.).
3- Moderate	The logger seems to be suffering from minor damages (i.e. sign of attempted stealing), but the logger is in place and condition can be restored.	Well-head is maintained, some minor damages are visible (i.e. attempt to break the house). The wellhead is in place and condition can be restored.	Moderately deteriorated parts, but auxiliaries are still functional, i.e. perforated pipe needs maintenance and cleaning, cables are slightly loose, housing and cabinet are damaged, gauge scale needs cleaning.	Moderately deteriorated canal, leakages are observable both in the bed and on banks, sediment deposit and flow measurements are not potentially affected.	Moderate condition (i.e. datalogger is surrounded by weed or aquatic plants in distant areas, foundation becomes instable due to canal deterioration etc.), water contamination is visible but not critical, environment degradation may have long-term effect.
2 - Good	No sign of damage or defect, minor signs of contamination that does not affect the operation, the logger is in place and condition can be certainly restored.	No sign of damage or defect, wellhead is well-maintained, some cleaning issues occur (i.e. water leaking into the house, etc.). The wellhead is in place and condition can be certainly restored.	No visible sign of damage or defect, auxiliaries are well-maintained, minor signs of maintenance issues, i.e. perforated pipe is slightly contaminated, cables need to be reinforced, housing and cabinet with lockers are undamaged, gauge scale is slightly contaminated.	Good condition, some leakage is observed, but it does not affect the asset performance and thus the flow measurements.	Good condition, some environmental issue (i.e. algae infestation, etc.) occur, but may not be harmful in long-term, water is clean.

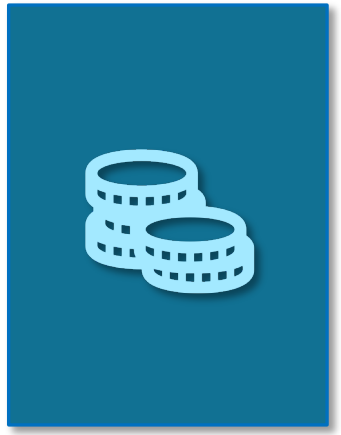
Financial analysis

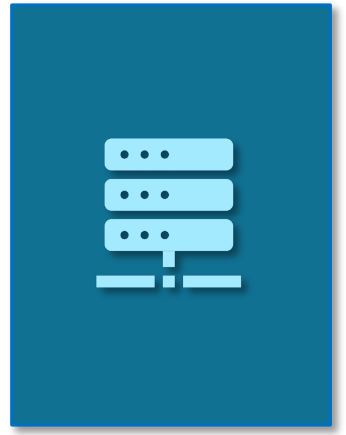
LIFE CYCLE COST ANALYSIS

Life-cycle costs (LCC): all cost associated with the ownership of irrigation assets over its entire life

Context: aligned calculation specifications (minimum cost categories)

Accuracy: deterministic and stochastic variables





Defined objective: provision of good irrigation service while generating revenue

File Edit Operate Tools Window Help

Food and Agriculture Organization of the United Nations

ASSET MANAGEMENT

Parshall flume MA | Sluice gate MA | Datalogger MA | Flowmeter MA | Life cycle cost

Select Gate : B3_GT

Condition score -guide | Condition score | Criticality score -guide | Criticality score | Gate manuals

Condition of the Asset (Condition Score) Guide

1. General maintenance level of fixed parts
Fixed parts are critically damaged, excessive corrosion on gate, cannot stop flow, needs immediate repair/replacement (5- Very poor)
Fixed part are partially damage/broken, excessive corrosion on gate surface, permanently leaking due to corrosion or damage, requires partial repair/replacement (4 - Poor)
Semi solid structure, structure is partially deteriorated, visible leakage, visible corrosion (3 - Moderate)
Solid structure, few visible defects, no visible leakage, minor signs of corrosion (2 - Good)
Solid structure, No visible defects, complete sealing, no visible corrosion (1 - Excellent)

2. General maintenance level of moving parts
Moving parts are critically damaged, important parts are missing, excessive corrosion on gate, cannot stop flow, needs immediate repair/replacement (5- Very poor)
Solid structure, few visible defects, no visible leakage, minor signs of wear and tear (4 - Poor)
Moderate deterioration, some parts are broken or missing, corrosion is visible, but gate is still functional, shows sign of leakage. (3 - Moderate)
Defective and deteriorated gate parts, some moving parts are missing, excessive corrosion occur, leaking gate, requires partial maintenance (2 - Good)
Moving parts in hard form, no defects, smooth operation, appropriately lubricated screws, provide complete sealing (1 - Excellent)

3. General maintenance level of cleaning
Critical dust/silt deposit, which prevents complete sealing, requires urgent maintenance, but corrosion is long-standing (5- Very poor)
Dust and corrosion are not removed, which prevent the exercising/moving, gate cannot fully close due to entrapped dust, silt, etc. maintenance is required (4 - Poor)
Moderate dust and silt deposit, cleaning is not regular, corrosion is visible, entrapped dust/silt cause gate leakage (3 - Moderate)
Gate is occasionally cleaned, no visible corrosion, but dust deposit is visible, no obstruction to moving parts (2 - Good)
Gate is regularly cleaned, all parts, rubber sealing are cleaned, no visible corrosion or dust/silt (1 - Excellent)

4. General maintenance level of surrounding canal section
Critically damaged canal section with major water loss, declined design capacity, which needs urgent repair or maintenance (5- Very poor)
Deteriorated canal section with major water loss and sediment deposit, which affects the design capacity (4 - Poor)
Moderately deteriorated canal, leakages are observable both in the bed and on banks, sediment deposit (3 - Moderate)
Good condition, some leakage is observed, but it does not affect the canal performance (2 - Good)
No visible defects, canal section is well-maintained, no leakage (1 - Excellent)

5. General maintenance level of surrounding environment
Critical environment condition, which is harmful for gate condition, immediate intervention is required (5- Very poor)
Damaging condition (i.e. loose casting due to soil erosion etc.) are long-standing, maintenance is required to avoid long-term effect (4 - Poor)
Moderate condition (i.e. design capacity is affected by weeding, casting affected by soil degradation etc.), environment degradation may have long-term effect (3 - Moderate)
Good condition, some environmental issue (i.e. weed infestation, canal construction, etc.) occur, but may not be harmful in long-term (2 - Good)
No visible damage, environment is well-maintained (1 - Excellent)

The tool

Food and Agriculture Organization of the United Nations

ASSET MANAGEMENT

emco controls

Parshall flume MA | Sluice gate MA | Datalogger MA | Flowmeter MA | Life cycle cost

Select Gate : B3_GT

Condition score -guide | Condition score | Criticality score -guide | Criticality score | Gate manuals

Condition of the Asset (Condition Score) Guide

1. General maintenance level of fixed parts
Fixed parts are critically damaged, excessive corrosion on gate, cannot stop flow, needs immediate repair/replacement (5- Very poor)
Fixed part are partially damage/broken, excessive corrosion on gate surface, permanently leaking due to corrosion or damage, requires partial repair/replacement (4 - Poor)
Semi solid structure, structure is partially deteriorated, visible leakage, visible corrosion (3 - Moderate)
Solid structure, few visible defects, no visible leakage, minor signs of corrosion (2 - Good)
Solid structure, No visible defects, complete sealing, no visible corrosion (1 - Excellent)

2. General maintenance level of moving parts
Moving parts are critically damaged, important parts are missing, excessive corrosion on gate, cannot stop flow, needs immediate repair/replacement (5- Very poor)
Solid structure, few visible defects, no visible leakage, minor signs of wear and tear (4 - Poor)
Moderate deterioration, some parts are broken or missing, corrosion is visible, but gate is still functional, shows sign of leakage. (3 - Moderate)
Defective and deteriorated gate parts, some moving parts are missing, excessive corrosion occur, leaking gate, requires partial maintenance (2 - Good)
Moving parts in hard form, no defects, smooth operation, appropriately lubricated screws, provide complete sealing (1 - Excellent)

3. General maintenance level of cleaning
Critical dust/silt deposit, which prevents complete sealing, requires urgent maintenance, but corrosion is long-standing (5- Very poor)
Dust and corrosion are not removed, which prevent the exercising/moving, gate cannot fully close due to entrapped dust, silt, etc. maintenance is required (4 - Poor)
Moderate dust and silt deposit, cleaning is not regular, corrosion is visible, entrapped dust/silt cause gate leakage (3 - Moderate)
Gate is occasionally cleaned, no visible corrosion, but dust deposit is visible, no obstruction to moving parts (2 - Good)
Gate is regularly cleaned, all parts, rubber sealing are cleaned, no visible corrosion or dust/silt (1 - Excellent)

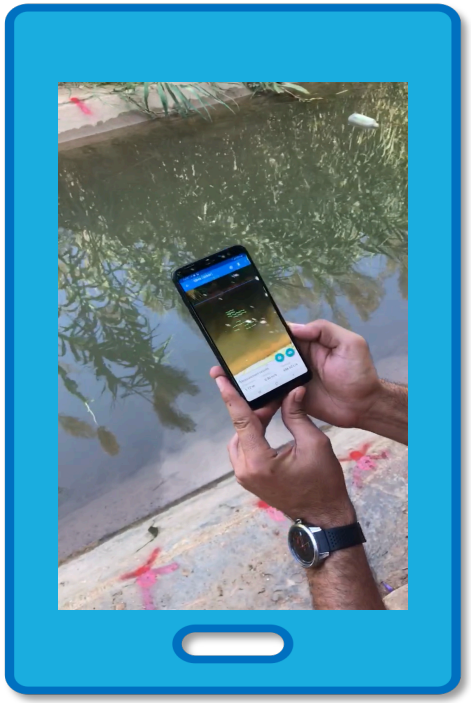
4. General maintenance level of surrounding canal section
Critically damaged canal section with major water loss, declined design capacity, which needs urgent repair or maintenance (5- Very poor)
Deteriorated canal section with major water loss and sediment deposit, which affects the design capacity (4 - Poor)
Moderately deteriorated canal, leakages are observable both in the bed and on banks, sediment deposit (3 - Moderate)
Good condition, some leakage is observed, but it does not affect the canal performance (2 - Good)
No visible defects, canal section is well-maintained, no leakage (1 - Excellent)

5. General maintenance level of surrounding environment
Critical environment condition, which is harmful for gate condition, immediate intervention is required (5- Very poor)
Damaging condition (i.e. loose casting due to soil erosion etc.) are long-standing, maintenance is required to avoid long-term effect (4 - Poor)
Moderate condition (i.e. design capacity is affected by weeding, casting affected by soil degradation etc.), environment degradation may have long-term effect (3 - Moderate)
Good condition, some environmental issue (i.e. weed infestation, canal construction, etc.) occur, but may not be harmful in long-term (2 - Good)
No visible damage, environment is well-maintained (1 - Excellent)

VALIDATION RESULTS

- Request to simplify the scoring criteria and language/staff turnover
- Make scoring "equipment-independent"
- Optimize allocated time

FUTURE STEPS



Crowed-sourcing based scoring

Forecasting of condition and performance

Finalization of LCC estimates and identification of alternative income sources

THANK YOU
FOR THE ATTENTION