RWH suitability on existing olive orchards in Rihab (Mafraq, Jordan)

August 2023

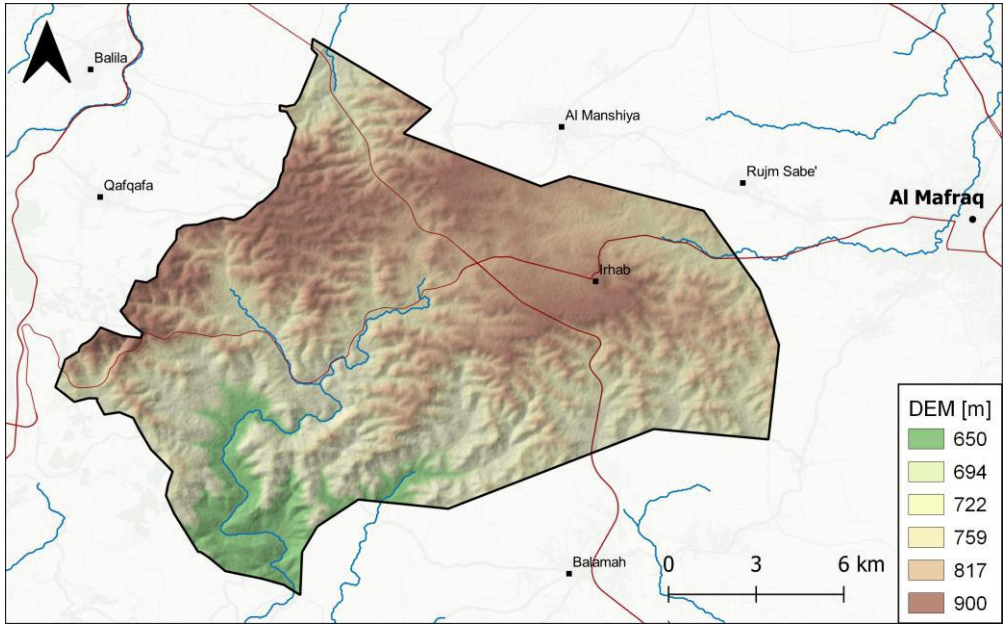
ACACIAWATER

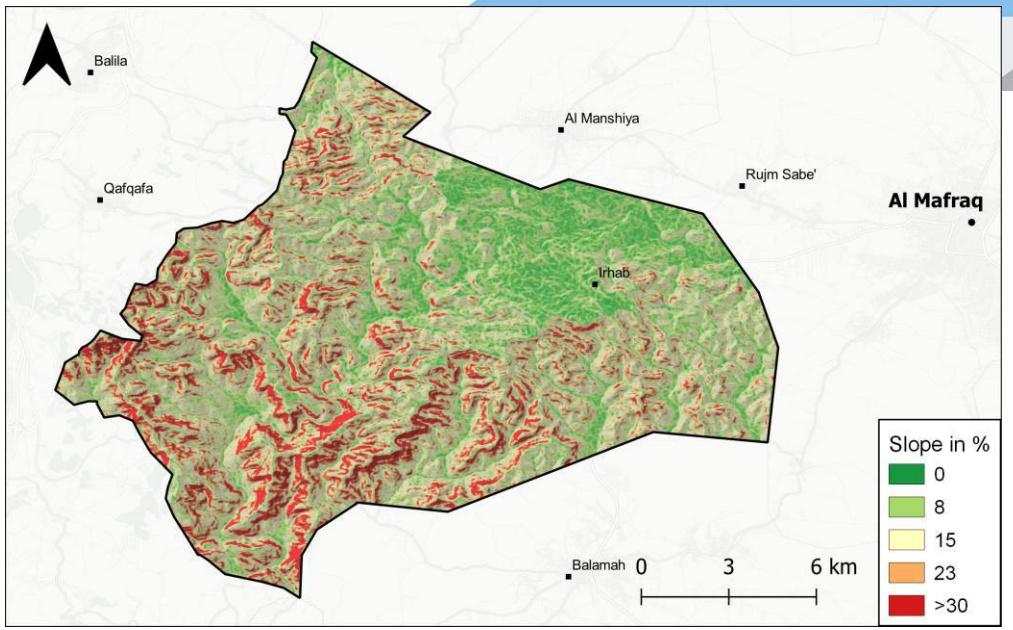
Objective and outline

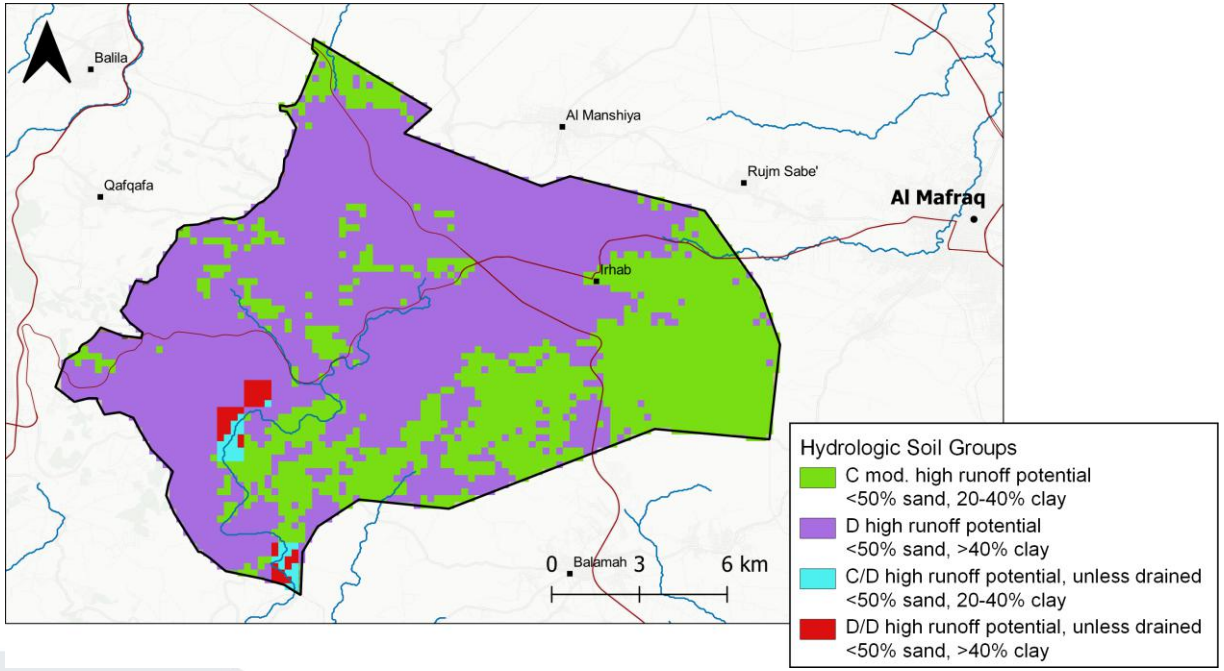
- Objective: to assess the biophysical suitability of different RWH structures that can be implemented on existing olive slopes in Rihab
- Implementation is done with a cash-for-work program
- Steps:
    0. Rihab, study area overview
    1. Overview possible interventions
    2. Suitability framework/approach
    3. Rank suitability scores of the interventions
    4. Weight/prioritize indicators
    5. Create suitability maps

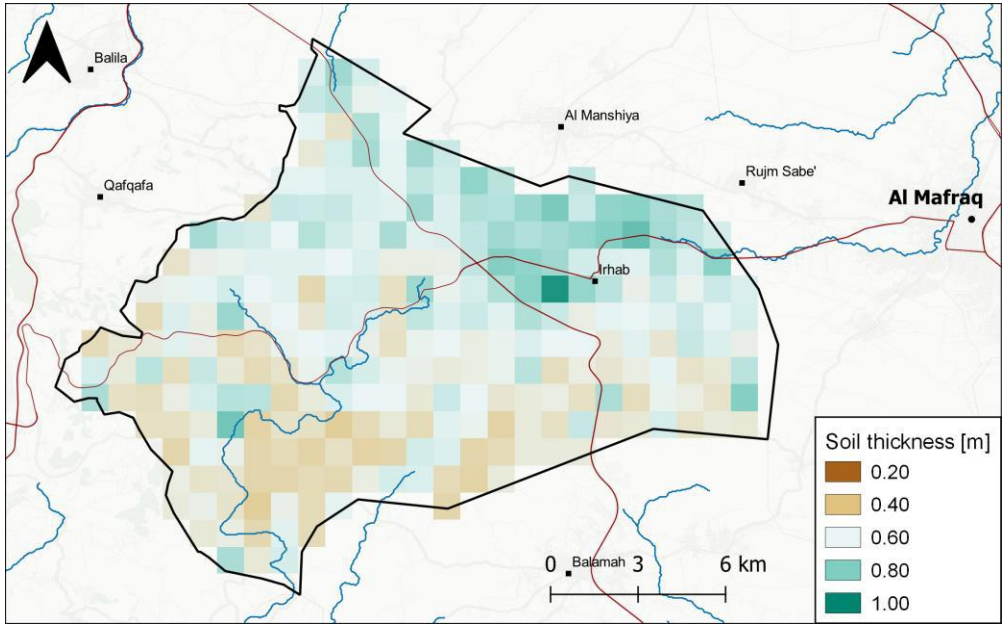
Rihab

- **Rainfall:** 200 – 350 mm/yr
- **Slopes:** mainly rolling (10-15%) and some gentle (2-5%), steeper slopes (>30%) can mainly be found in the southwest of the sub-district
- **Hydrological Soil Groups:** mainly soils with medium and high run-off potential
- **Soil depths:** mostly shallow to moderately deep (40-80cm), small portion is deeper than 80 cm. Note that this is based on the used input dataset, field observations have revealed the occurrence of very shallow soils and rock outcrops within the study area!!


Balila
Al Manshiya
Qafqafa
Rujm Sabe'
Al Mafraq
Irhab
Balamah
0 3 6 km
DEM [m]
650
694
722
759
817
900


Balila
Al Manshiya
Qafqafa
Rujm Sabe'
Al Mafraq
Irhab
Balamah 0 3 6 km
Slope in %
0
8
15
23
>30


Balila
Al Manshiya
Qafqafa
Rujm Sabe'
Al Mafraq
Irhab
0 Balamah 3 6 km
Hydrologic Soil Groups
C mod. high runoff potential
<50% sand, 20-40% clay
D high runoff potential
<50% sand, >40% clay
C/D high runoff potential, unless drained
<50% sand, 20-40% clay
D/D high runoff potential, unless drained
<50% sand, >40% clay

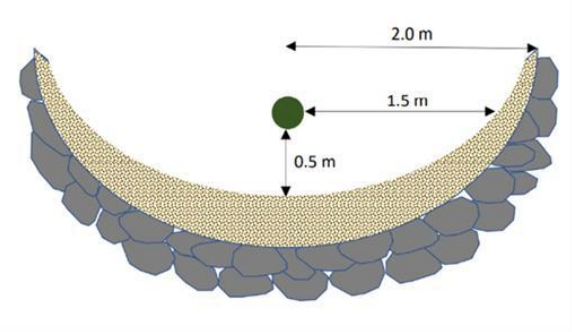

Balila
Al Manshiya
Qafqafa
Rujm Sabe'
Al Mafraq
Irhab
0 Balamah 3 6 km
Soil thickness [m]
0.20
0.40
0.60
0.80
1.00

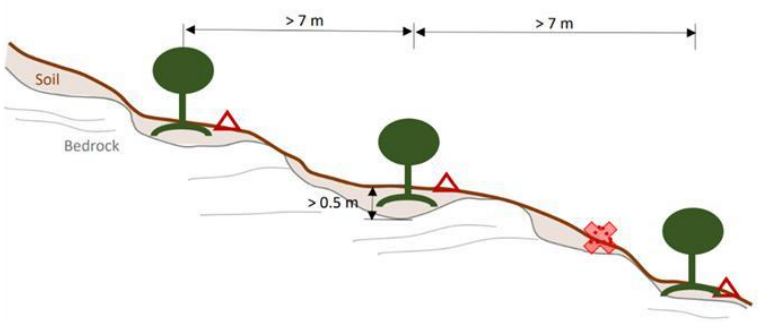
1: Possible Interventions

1. Semi-circular bunds (reinforced with stones)
2. Contour (soil) bunds
3. V-shaped micro-catchments
4. Bench terraces

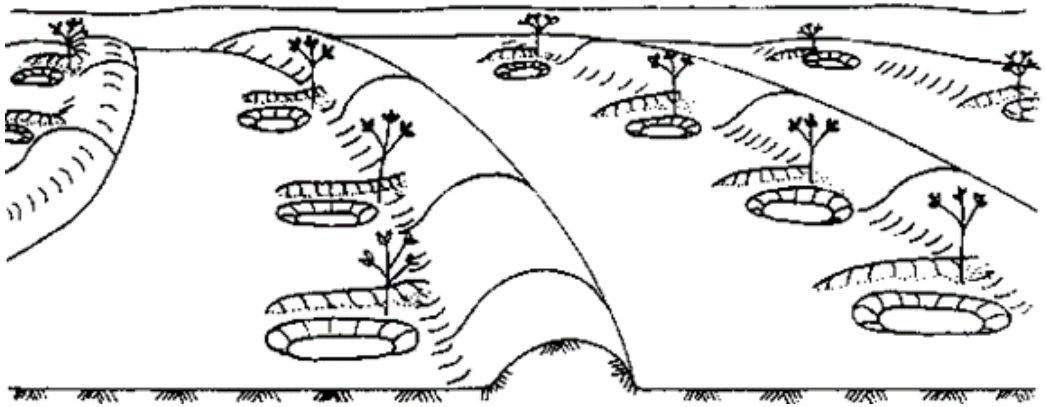
1.1: Semi-circular bunds

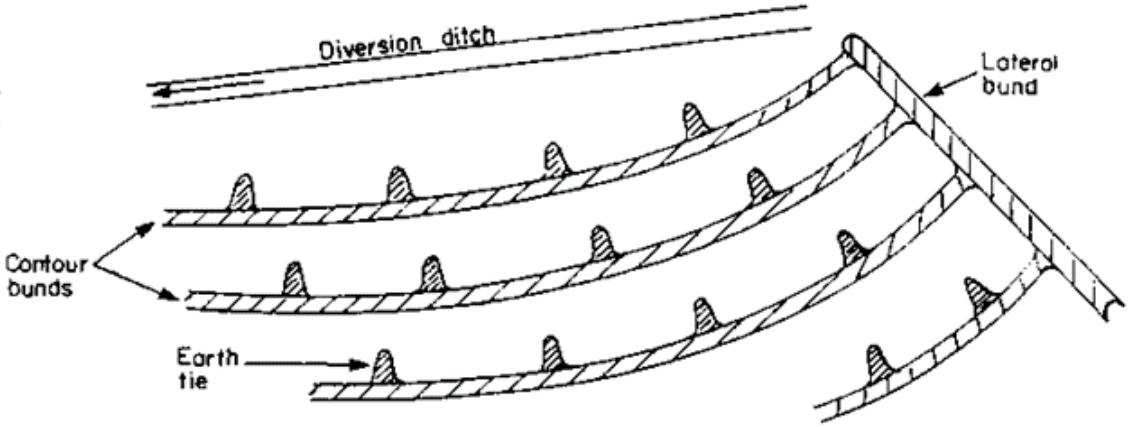
- Bunds with stones (and compacted soil)
- Slopes around 6-30%
- Examples:
  - Summary (wocat.net) (Palestine)
  - WOCAT SLM Technologies (Syria)





1.2: Contour bunds for trees



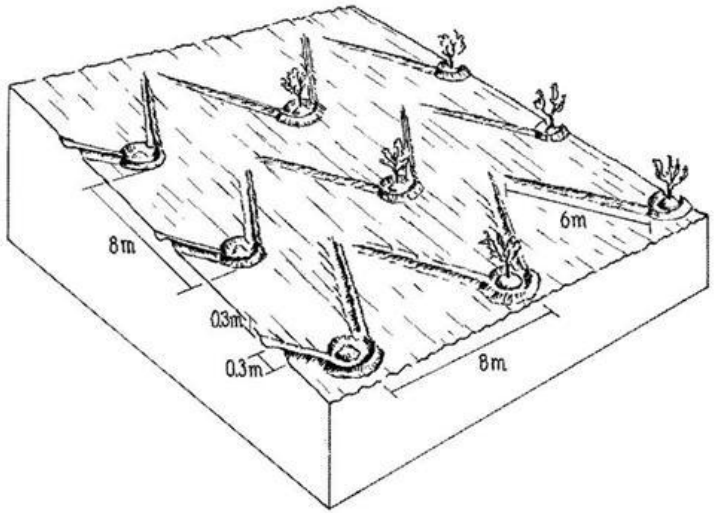


- Contour soil bunds
- Slopes <5%
- No gullies/rills should exist in the landscape
- Examples:
  - 5. Water harvesting techniques (fao.org)

Size Unit Microcatchment			Volume Earthworks per Unit	No. Units per ha	Earthworks m^3/ha
Bund spacing	Tie spacing	Area (m^2)	(m^3)		
5m	2m	10	0.5	1000	500
5m	5m	25	0.9	400	360
5m	10m	50	1.5	200	300
10m	2.5m	25	0.6	400	240
10m	5m	50	0.9	200	180

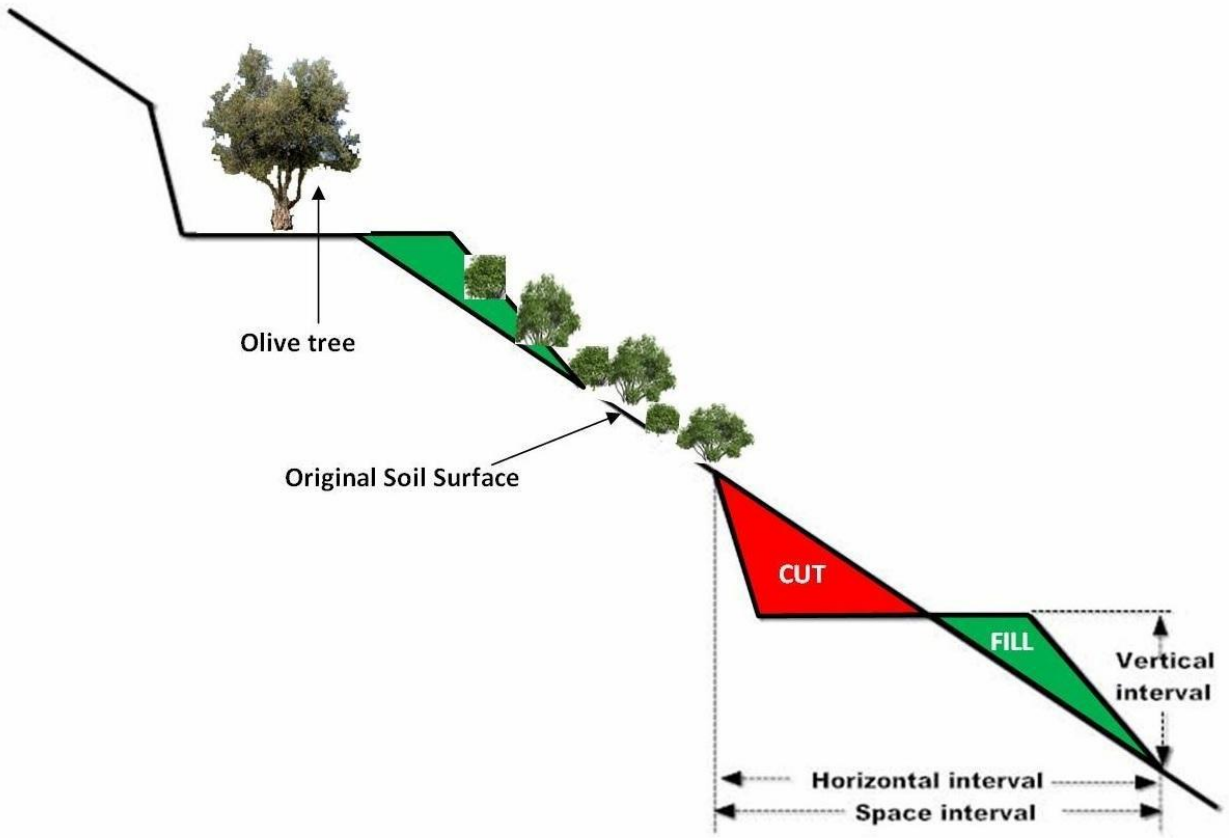
1.3: Shallow V-shapes

- Implemented with conventional ploughs in marginal regions (<200 mm of rainfall)
- Slopes around 6-10%
- Examples:
  - WOCAT SLM Technologies (Syria)
  - 5. Water harvesting techniques (fao.org)

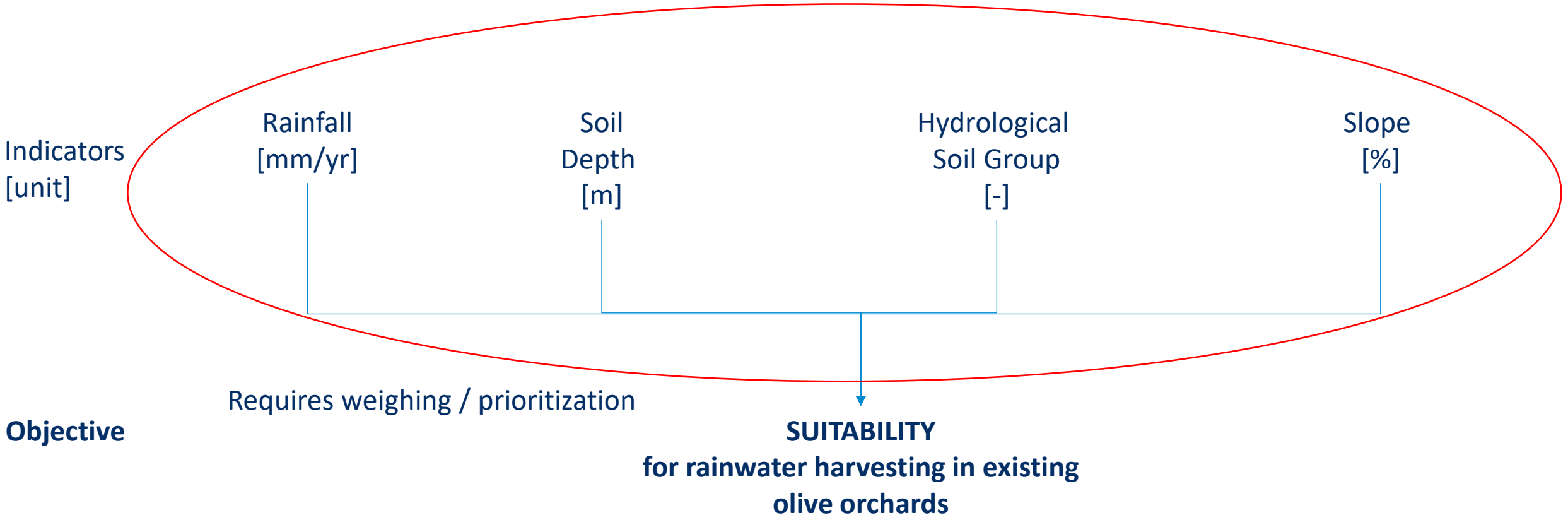


1.4: Terraces

- Implemented on medium to steep slopes (10-65%)
- Examples:
  - Summary (wocat.net) (Greece)
  - WOCAT SLM Technologies (Afghanistan)



2: Suitability approach



2. Suitability input data

- **Soil depth:** Global 1-km Gridded Thickness of Soil, Regolith, and Sedimentary Deposit Layers (Pelletier et al., 2016)
  - Global 1-km Gridded Thickness of Soil, Regolith, and Sedimentary Deposit Layers (ornl.gov)
- **Hydrological Soil Group:** Global Hydrologic Soil Groups (HYSOGs250m) for Curve Number-Based Runoff Modeling (Ross et al., 2018)
  - Global Hydrologic Soil Groups (HYSOGs250m) for Curve Number-Based Runoff Modeling (ornl.gov)
- **Rainfall**: Climate Hazards Group InfraRed Precipitation With Station Data (CHIRPS) (Funk et al., 2015)
  - The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes | Scientific Data (nature.com)
- **Slope:** derived from NASA SRTM Digital Elevation 30m (Farr et al., 2007)
  - The Shuttle Radar Topography Mission - Farr - 2007 - Reviews of Geophysics - Wiley Online Library

3. Suitability Scoring

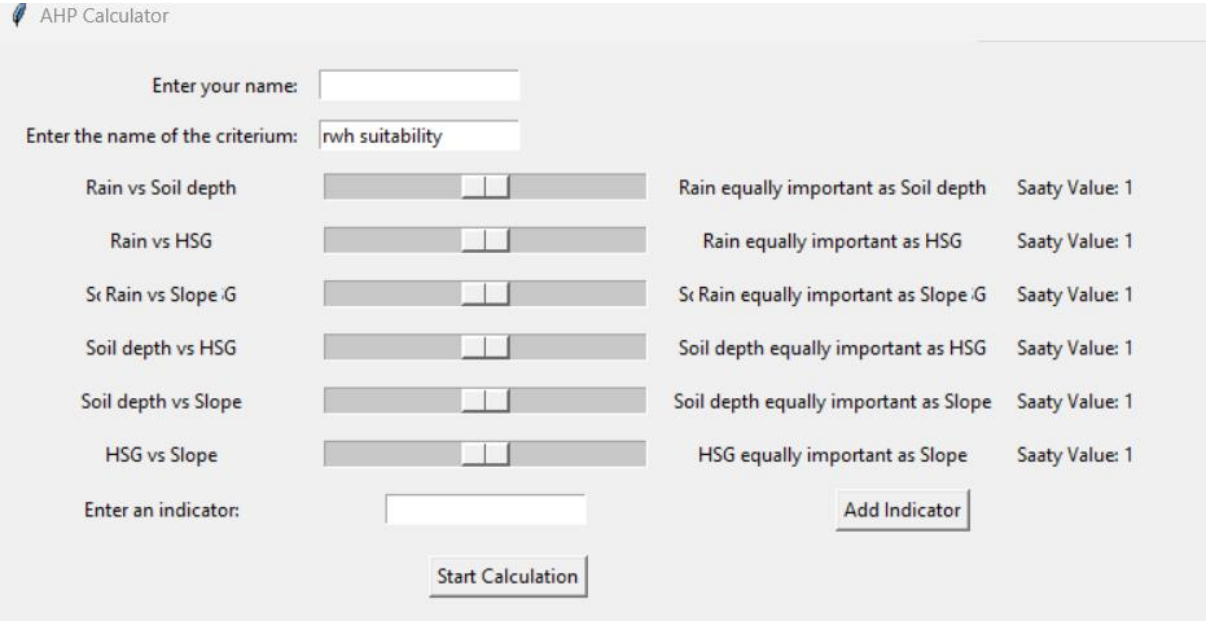
- 5 suitability classes
- For each intervention, a suitability score was assigned to the indicator

Suitability Score	*Suitability*
0	Not suitable
1	Poorly suitabile
2	Somewhat suitable
3	Moderately suitable
4	Highly suitable
5	Perfectly suitable

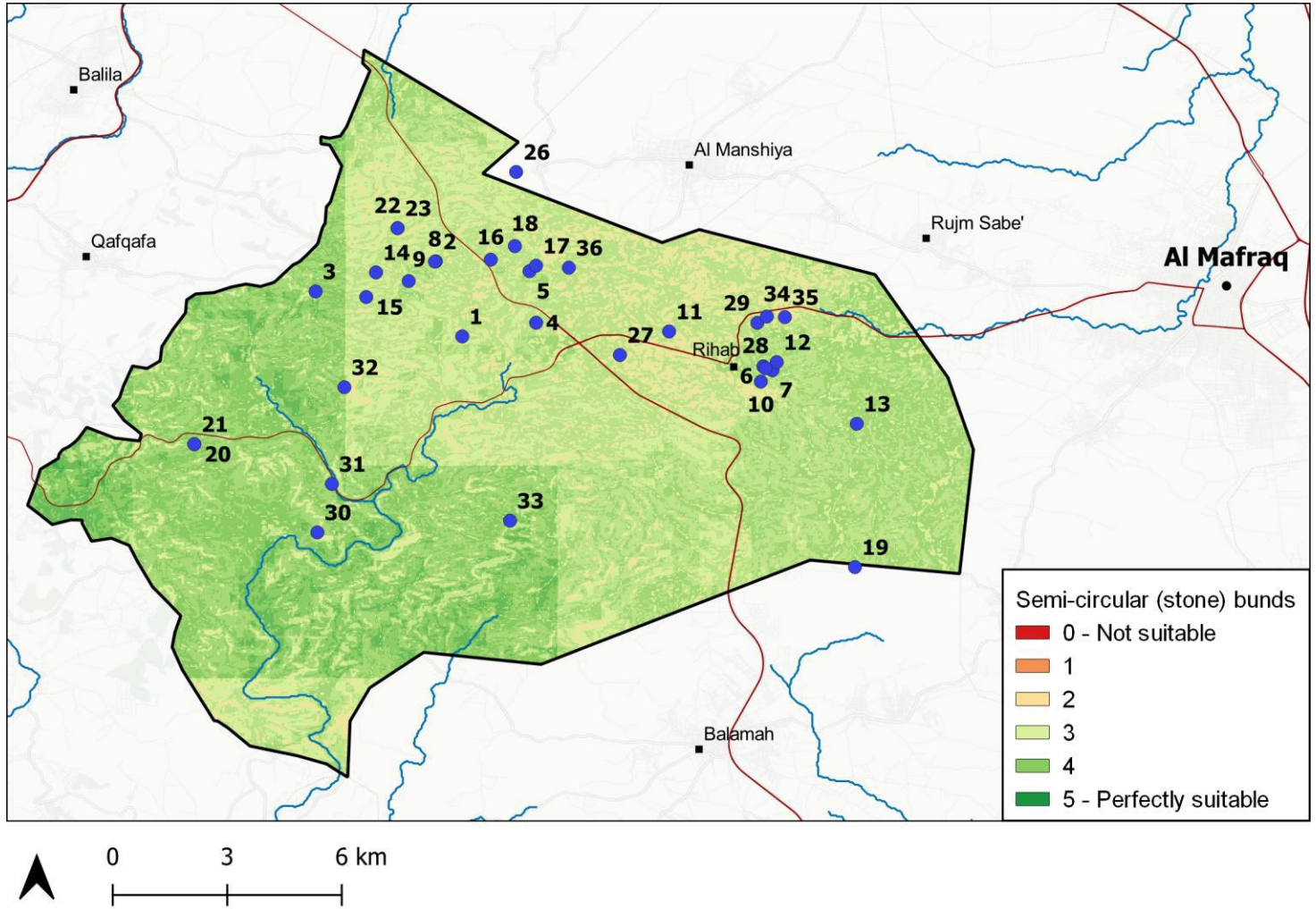
Indicator	Class	Lower	Upper	Unit	Semi-Circular Bunds	Contour Bunds	V-shaped microcatch.	Bench Terraces
Rainfall	Very dry	0	230	mm/yr	2	5	5	3
Rainfall	Dry	230	280	mm/yr	4	5	3	4
Rainfall	Moist	280	600	mm/yr	5	4	3	5
Soildepth	Very shallow	0	20	cm	3	1	1	0
Soildepth	Shallow	20	50	cm	5	3	5	2
Soildepth	Moderately deep	50	80	cm	5	5	5	4
Soildepth	Deep	80	120	cm	5	5	5	5
HYSOG	C: Medium run-off	3	3		5	5	5	5
HYSOG	C/D: Medium run-off, unless drained	13	13		5	5	5	5
HYSOG	D: High run-off	4	4		3	3	3	3
HYSOG	D/D: High run-off, unless drained	14	14		3	3	3	3
Slope	Flat	0	2	%	2	5	2	0
Slope	Gentle	2	5	%	3	4	5	0
Slope	Moderate	5	10	%	5	1	4	1
Slope	Rolling	10	15	%	5	0	2	3
Slope	Hilly	15	30	%	4	0	1	5
Slope	Steep	30	100	%	2	0	0	5

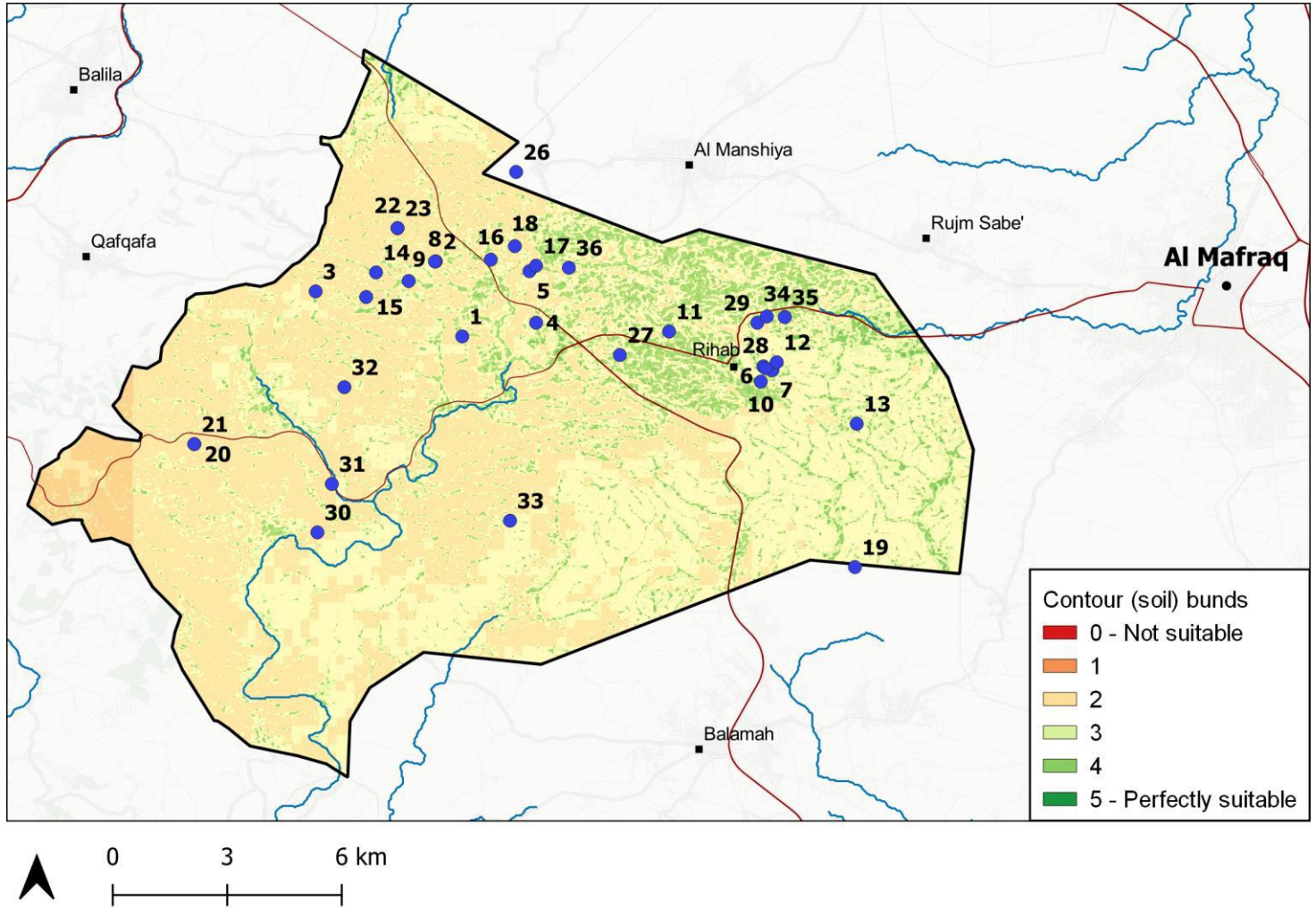
4. Weighing / prioritizing

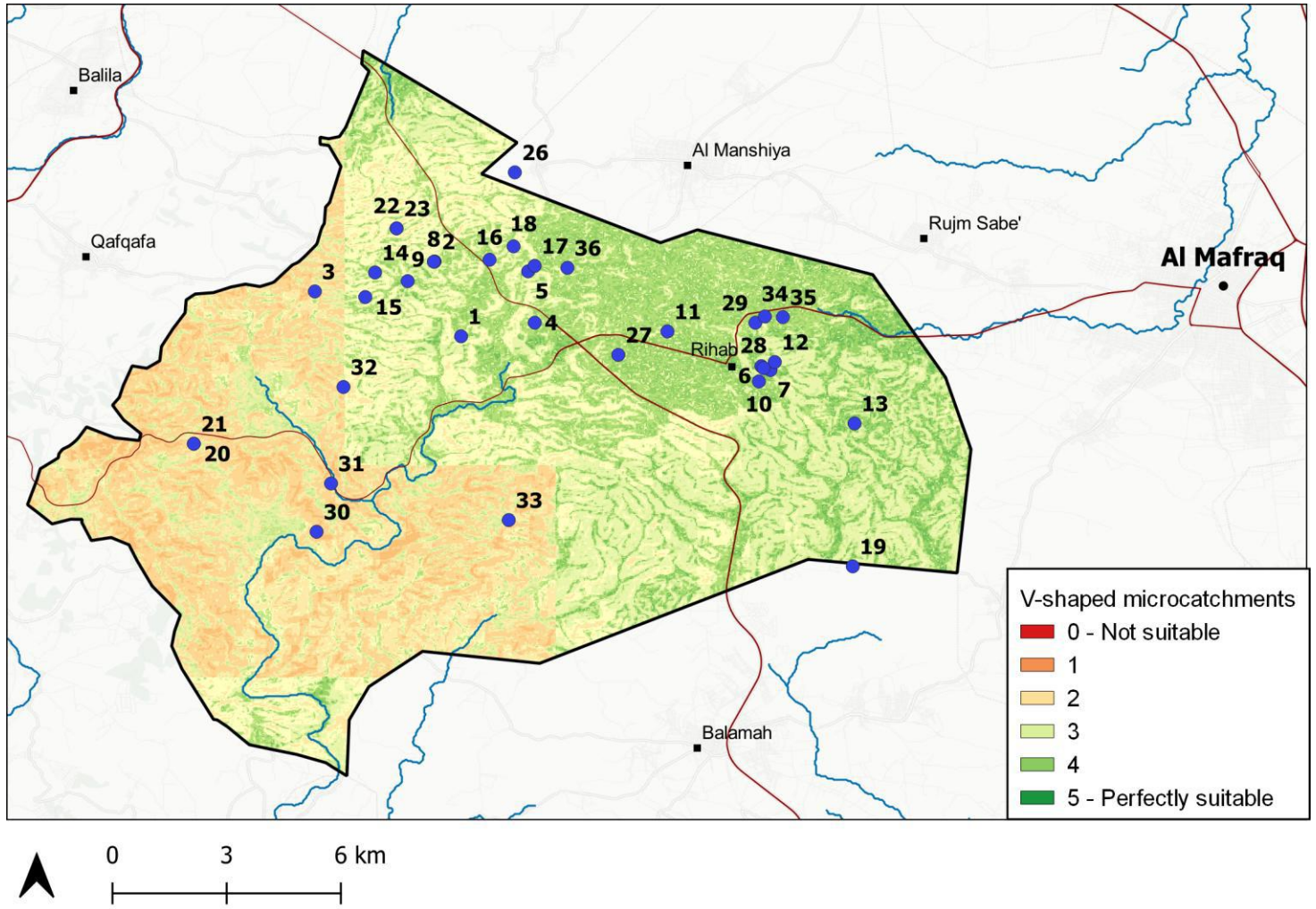
- Used pairwise comparisons to quantify weights
- Decided to use the following weights:
  - Slope: 35%
  - Rainfall: 30%
  - Soil depth: 20%
  - HYSOG: 15%



5. Suitability maps




Balila
Qafqafa
Al Manshiya
Rujm Sabe'
Al Mafraq
Rihab
Balamah
26
22 23
18
16
8 2
17 36
14 9
3
5
15
1
4
11
29
34 35
27
28
12
6
7
10
13
32
21
20
31
30
33
19
Contour (soil) bunds
0 - Not suitable
1
2
3
4
5 - Perfectly suitable
0
3
6 km


Balila
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14 9
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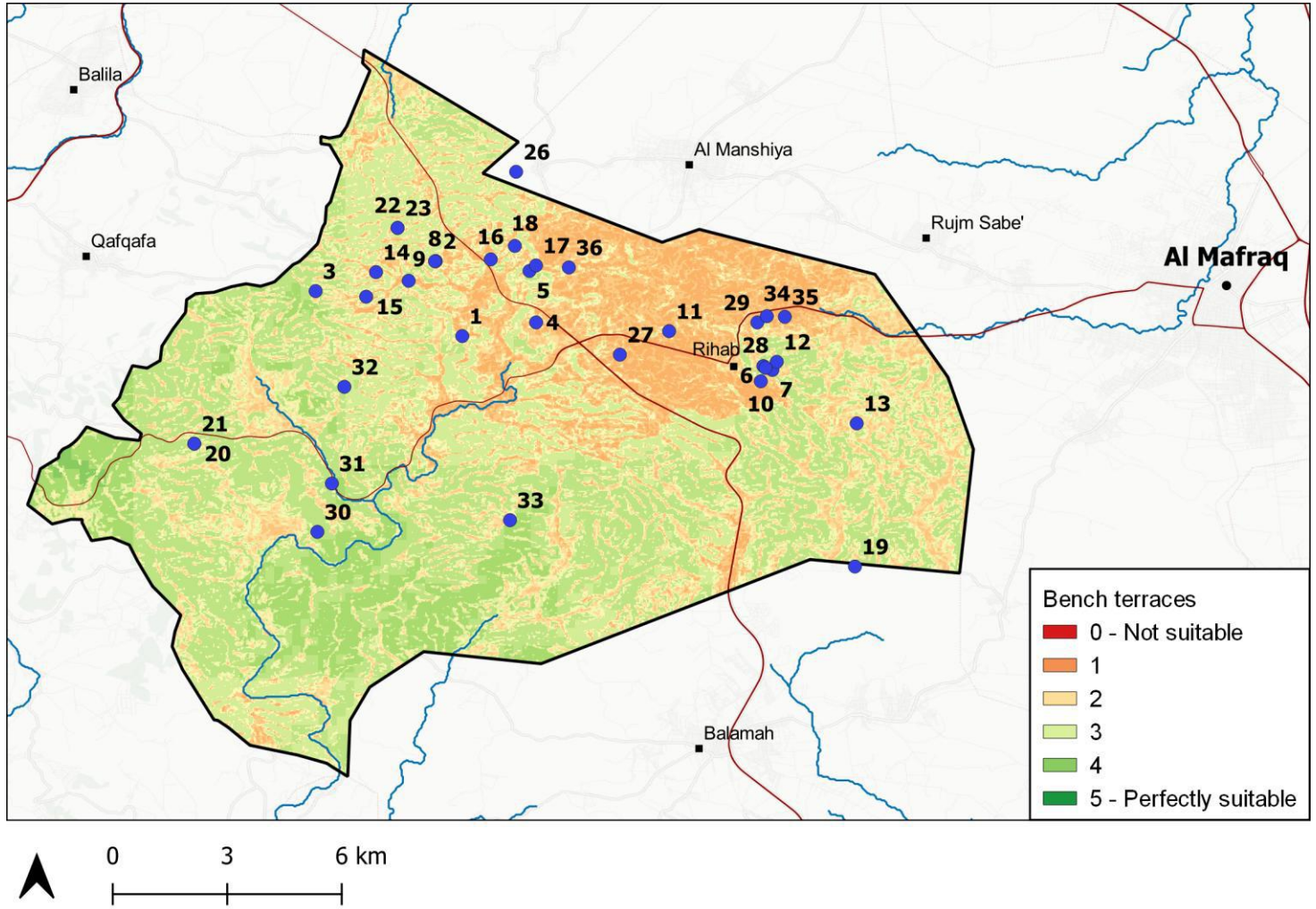
34 35
27
28 12
6
7
10
13
32
21
20
31
33
30
19
V-shaped microcatchments
0 - Not suitable
1
2
3
4
5 - Perfectly suitable
0
3
6 km


Balila
Al Manshiya
Qafqafa
Rujm Sabe'
Al Mafraq
Rihab
Balamah
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82
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9
3
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1
4
11
29
34
35
27
28
12
6
7
10
13
32
21
20
31
30
33
19
Bench terraces
0 - Not suitable
1
2
3
4
5 - Perfectly suitable
0
3
6 km

BEFORE IMPLEMENTATION

- **Check exact locations of slopes:** as the analysis relies on spatial data, the exact coordinates of the slopes (instead of the farms) should be used to derive the final suitability scores.
- **Double check soil depth in field:** datasets shows the *average* soil depth at 1km resolution. As observed in the field, soils can be shallower locally (e.g. rock outcrops or very shallow soils < 20cm)
- **On-site validation:** suitability mapping serves as a practical tool and is based on open-source data only. When selecting the final locations, on-site verification is important. When necessary, minor design refinements can be made to tailor the selected intervention to the specific site conditions.