Status and challenges of soil management in the Middle East

"Managing Living Soils" - Technical Workshop

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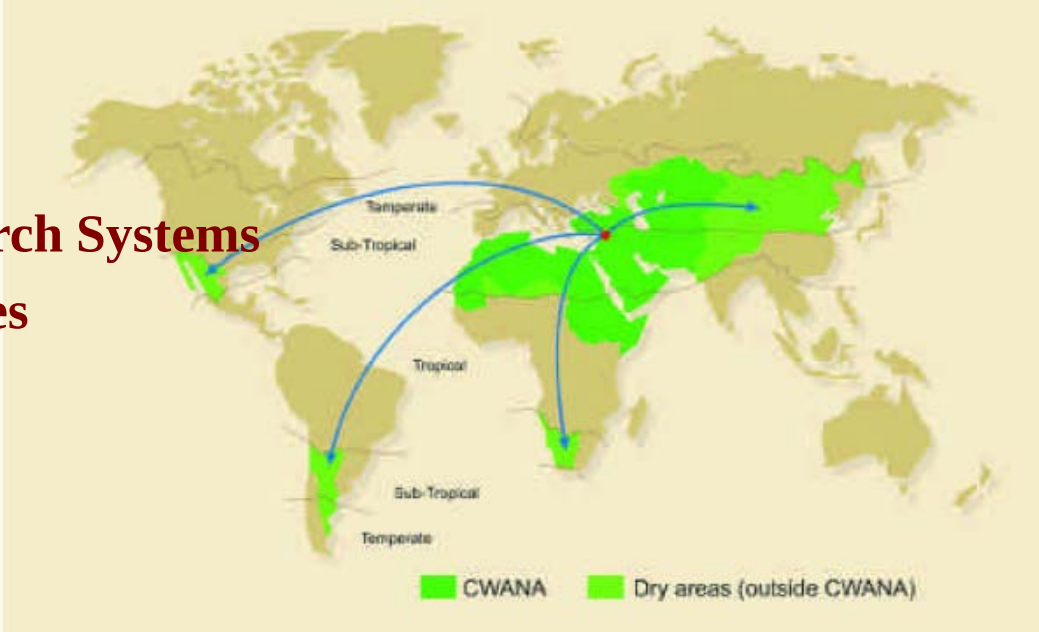
About ICARDA

One of 15 CGIAR centres
(Consultative Group on International Agricultural Research)

Vision: Improved livelihoods of the resource-poor in the dry areas

Geographic Mandate: non tropical dry areas



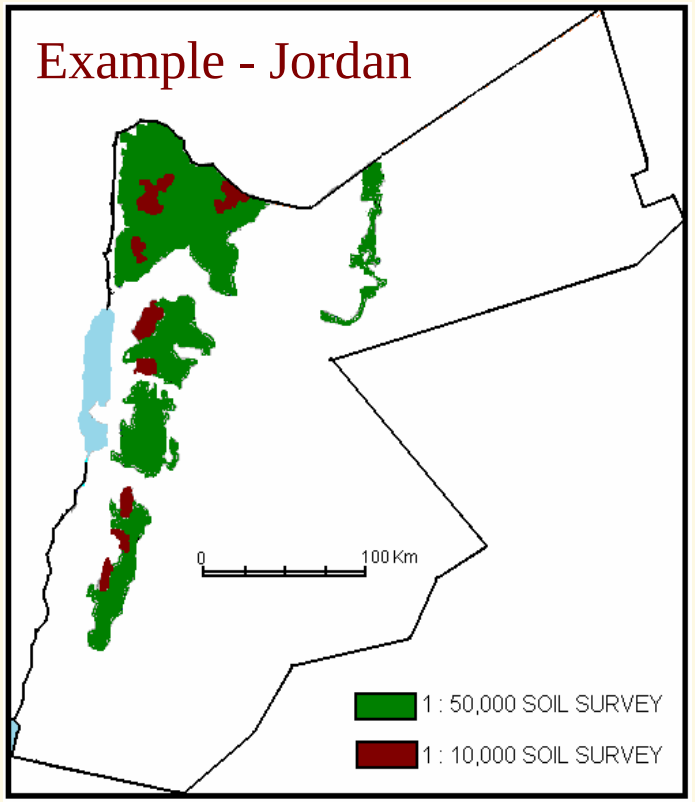
Partners:

- National Agricultural Research Systems
- Advanced Research Institutes
- Development organizations
- Rural communities

Challenges for sustainable soil management

- Limited areas with detailed data
- High Cost to cover more areas
- Purity of mapping units
- Site-specific Management
- Environmental modelling
- Spatial and temporal changes
- Institutional challenges

  (within and among countries)



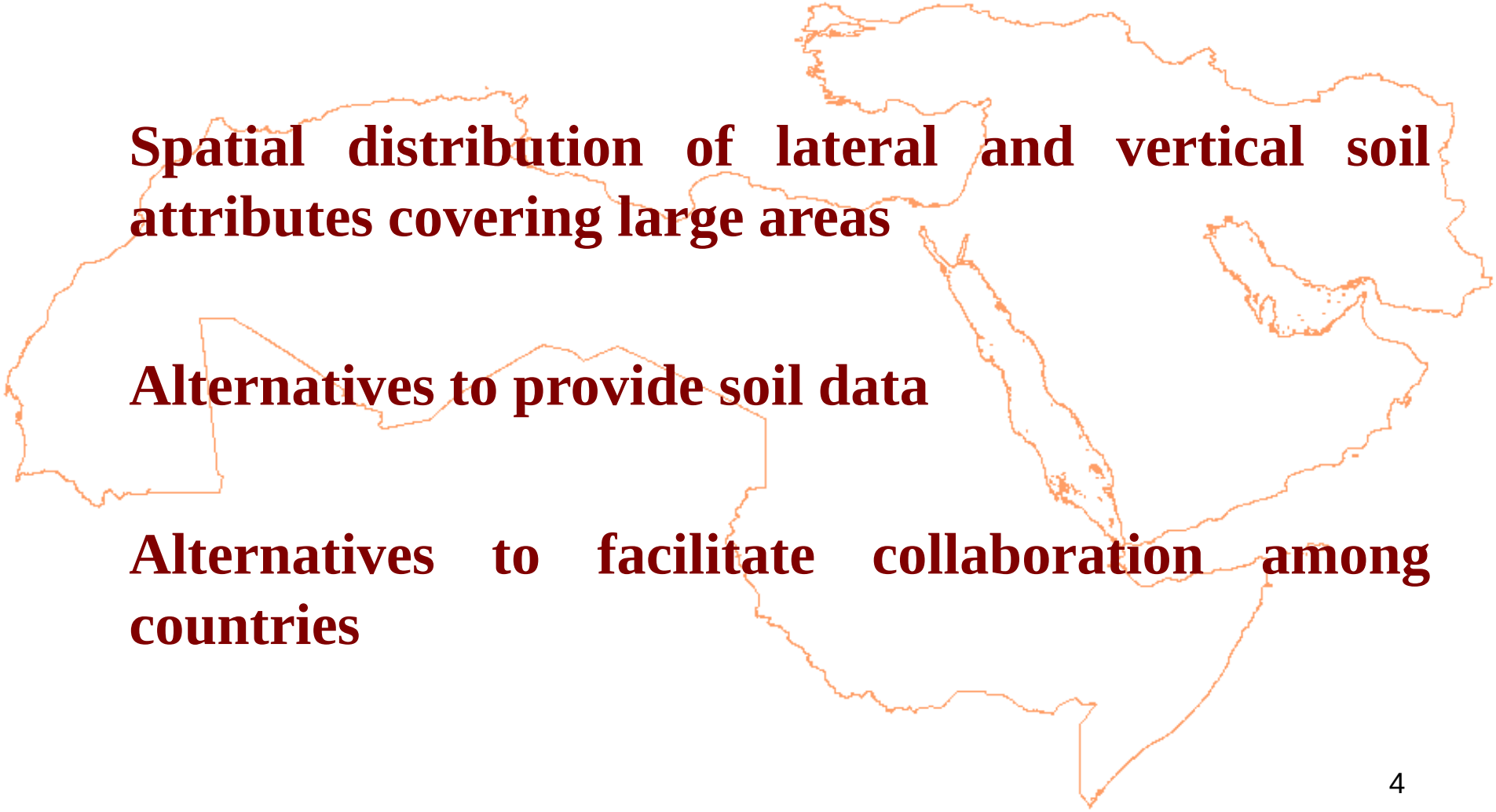
Soil data for sustainable land management

We need:

Spatial distribution of lateral and vertical soil attributes covering large areas

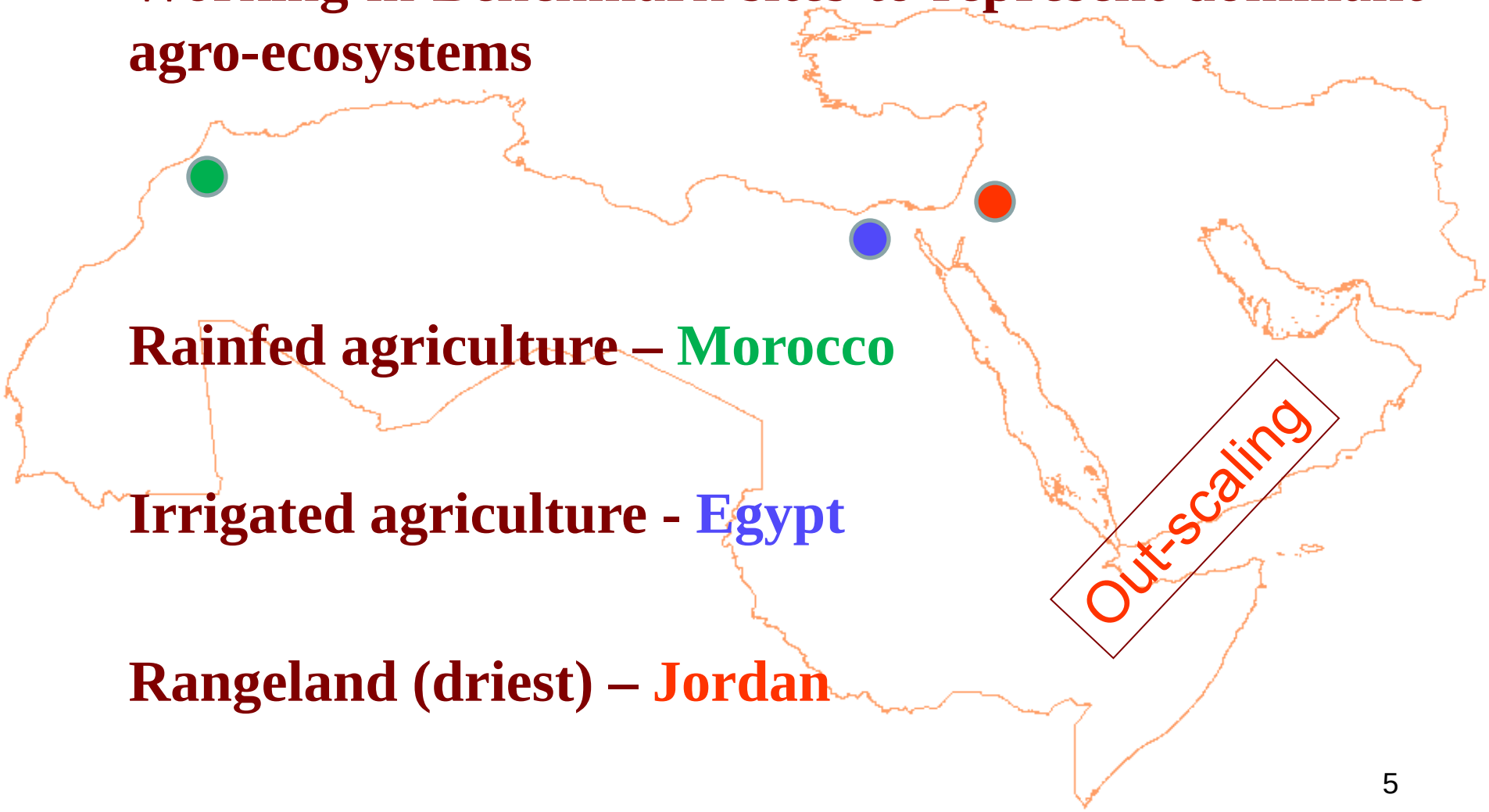
Alternatives to provide soil data

Alternatives to facilitate collaboration among countries



Handling data scarcity and data sharing difficulties

Working in Benchmark sites to represent dominant agro-ecosystems

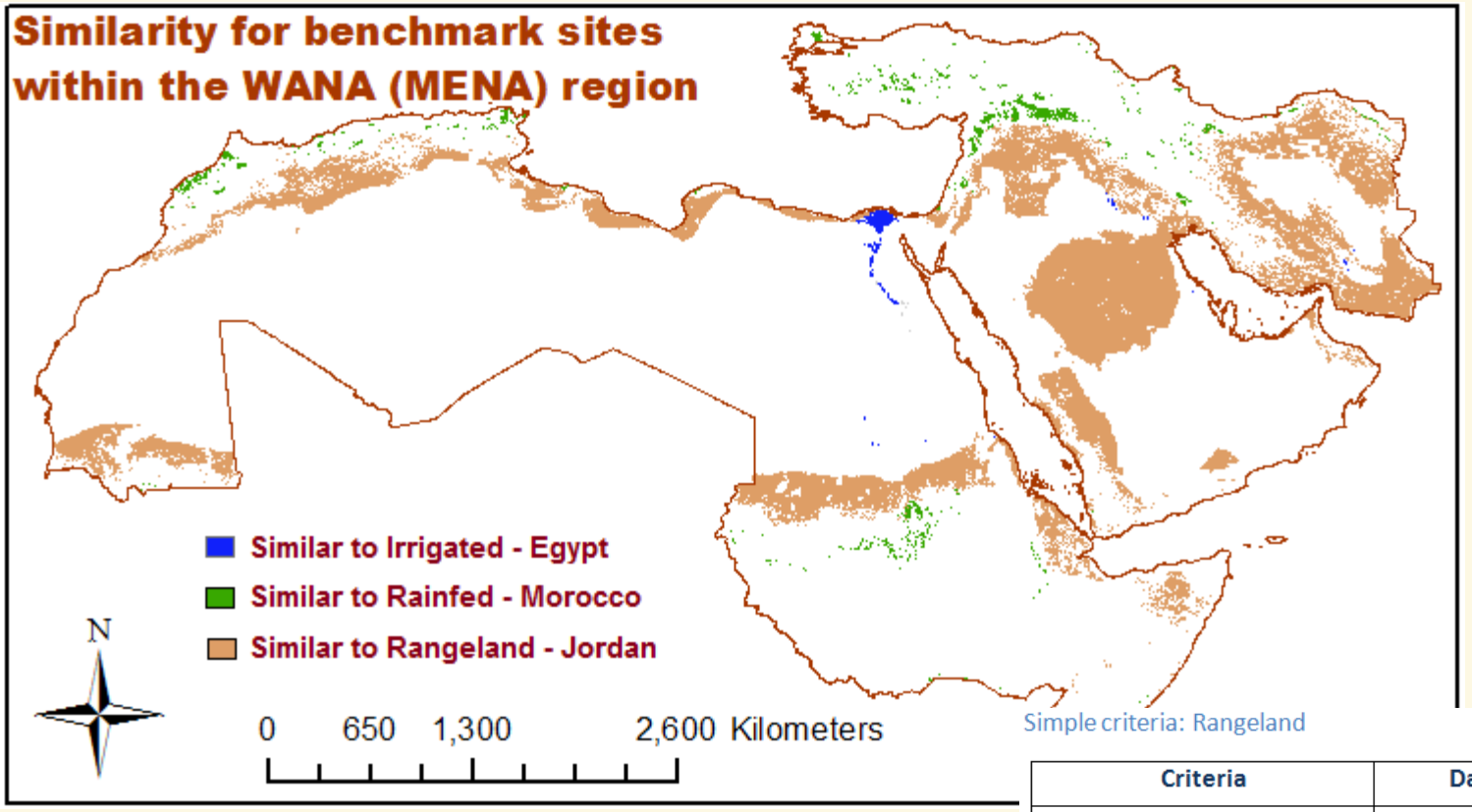


Rainfed agriculture – Morocco

Irrigated agriculture - Egypt

Rangeland (driest) – Jordan

Similarity maps for three agro-ecosystems



Simple criteria: Rangeland

Criteria	Data source
Rainfall: 100-300 mm	Global rainfall map
Soil depth: minimum 60 cm	FAO Soil map
Vegetation cover: < 30%	Global land use map
Slope up to 30%	Derived from DEM

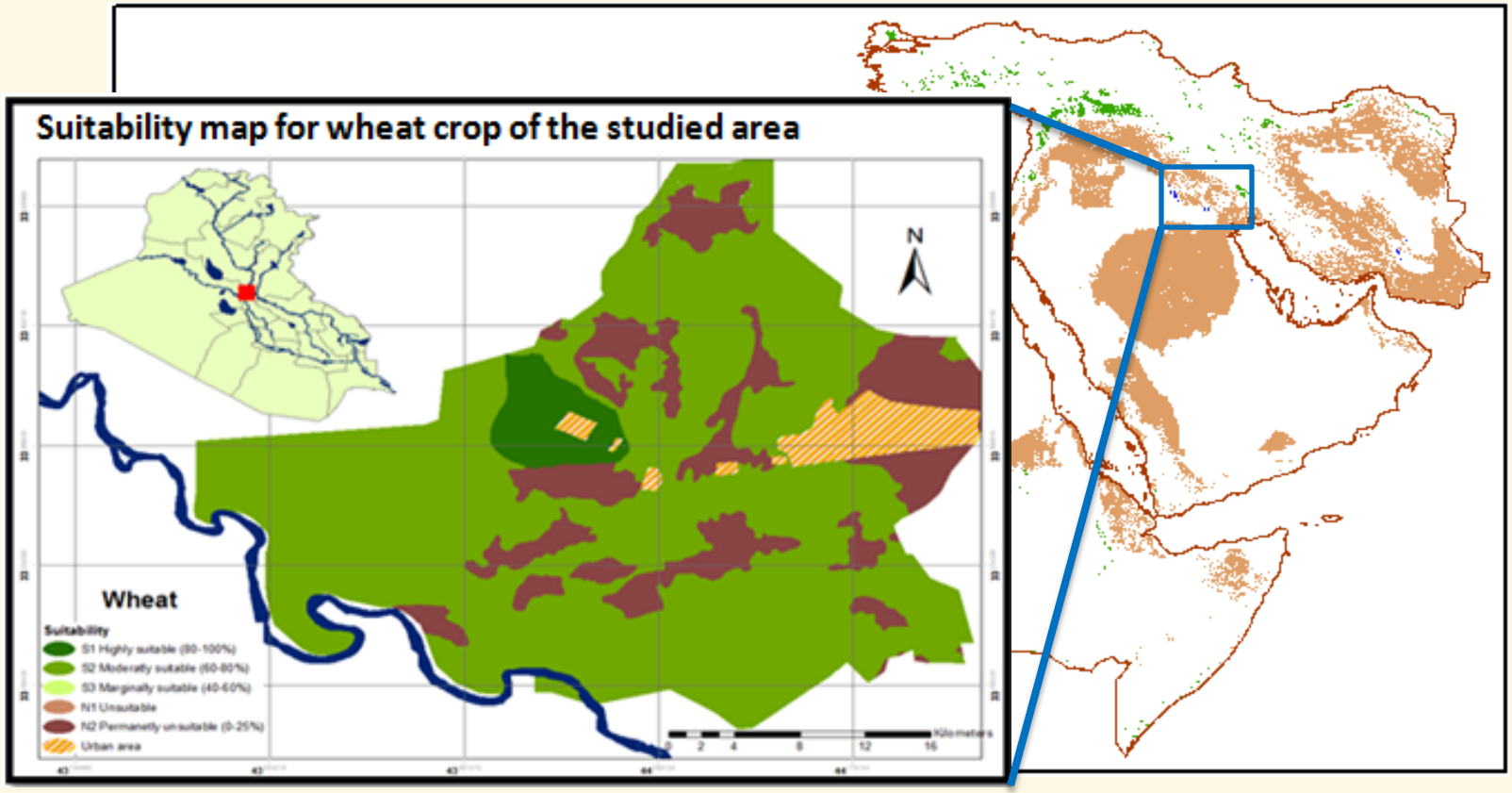
Enable screening of similar areas for focusing

Independent of location among country

Coarse maps at regional level & verification at country level

Allow data integration and out-scaling

Detailed Suitability maps for similar areas



Use detailed data within country, but

Out-scalable to other countries with similar bio-physical conditions

Alternative sources of soil information

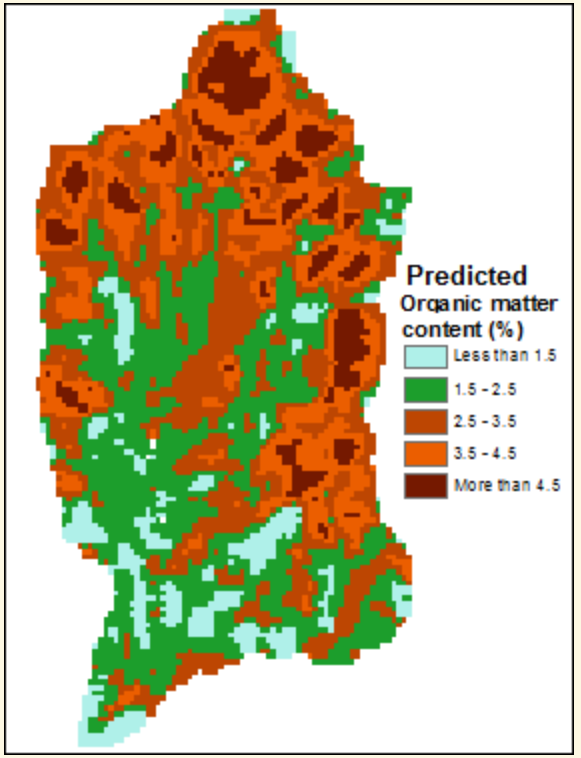
Developments in new technologies; GIS and remote sensing provide new approaches to meet the demand of resource-related modelling

Regression models within sub-watersheds to predict soil attributes

Attribute oriented outputs

Needed for current applications

Reasonable cost and expandable coverage



Accuracy of the predicted soil characteristics was generally better than those derived from traditional soil map (scale 1:5,000)

Chemical, physical, and soil fertility related attributes for the surface and sub-surface soils

Soil variables	RMSE Prediction	RMSE Soil map	Soil variables	RMSE Prediction	RMSE Soil map
Carbonate % A[(a)]	3.4	8.6	Silt % A	13.5	10.6
Carbonate % B[(a)]	10.5	16.0	Silt % B	24.5	23.1
Organic Matter % A	0.5	0.4	Clay % A	7.1	12.8
Organic Matter % B	0.4	0.4	Clay % B	24.1	30.4
pH A	0.3	0.7	Depth (cm) A	6.4	11.0
pH B	3.4	3.8	Depth (cm) B	35.5	53.3
EC (dS/m) A	0.3	0.4	Soil Depth (cm)	33.5	56.8
EC (dS/m) B	0.8	1.4	No .of horizons	1.1	1.4
Bulk Density (g cm^{-3}) A	0.2	0.2	Stone % A	10.8	12.6
Bulk Density (g cm^{-3}) B	0.6	0.7	Stone % B	20.8	11.1
Sand % A	14.1	18.2	Surface stone %	13.1	23.2
Sand% B	8.7	12.2			

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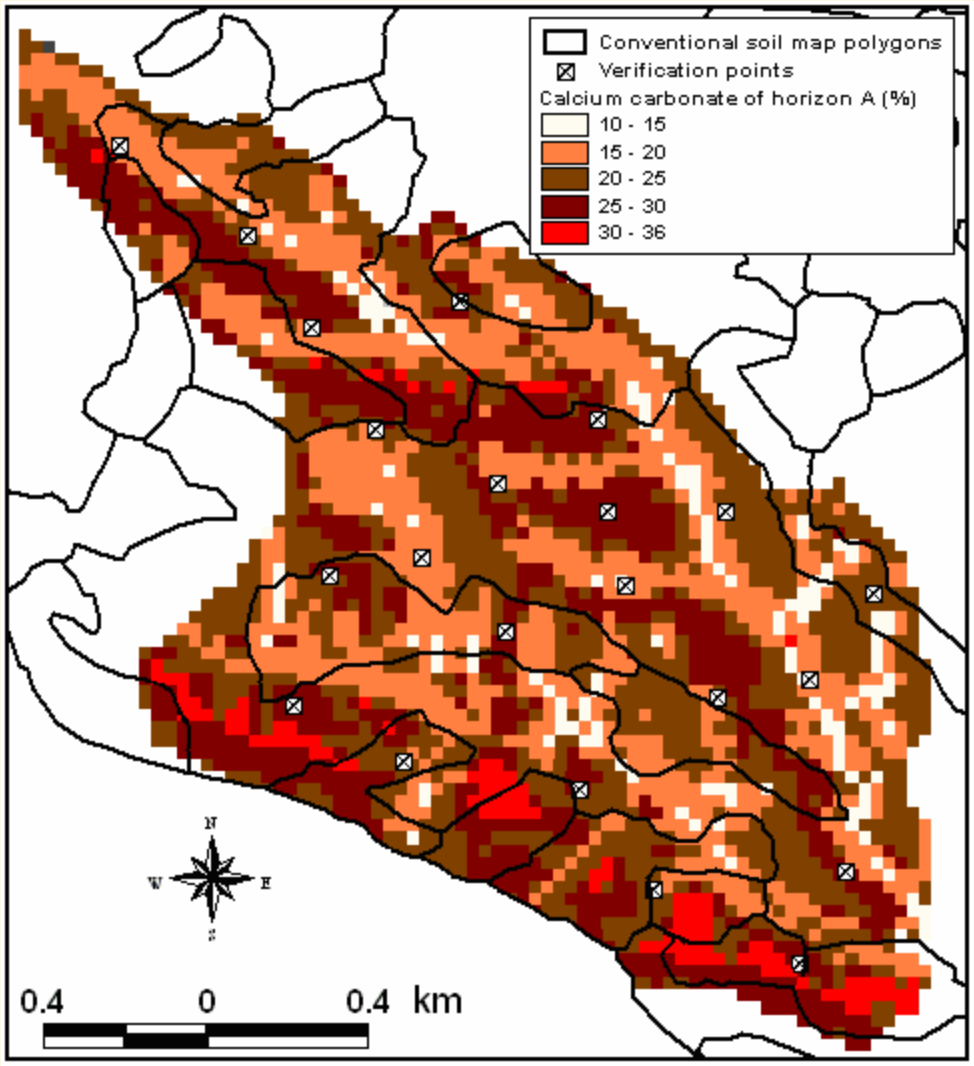
Spatial distribution of the predicted soil characteristic is better than those of the traditional soil map

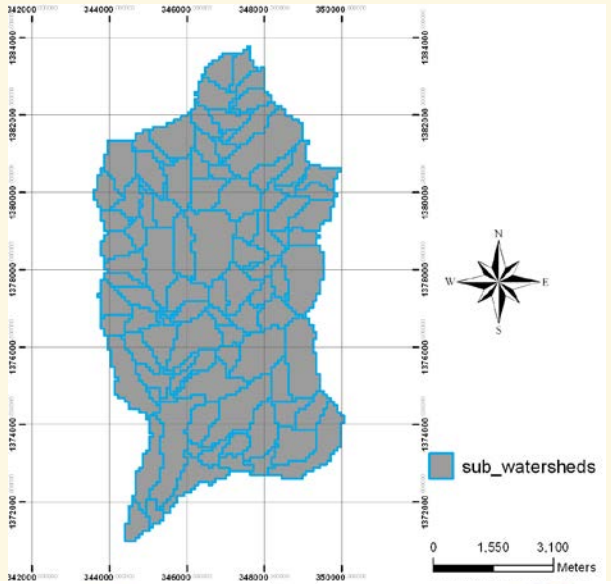


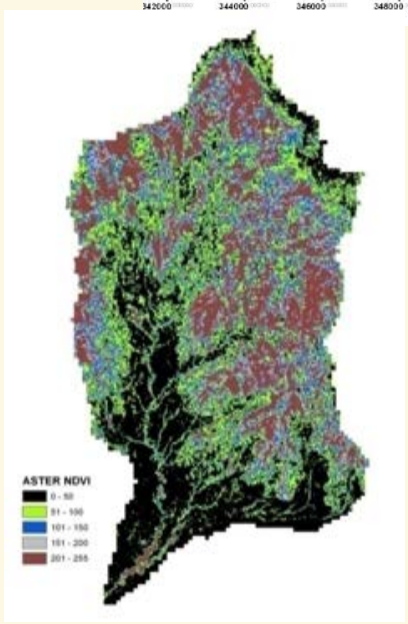
Application in various countries

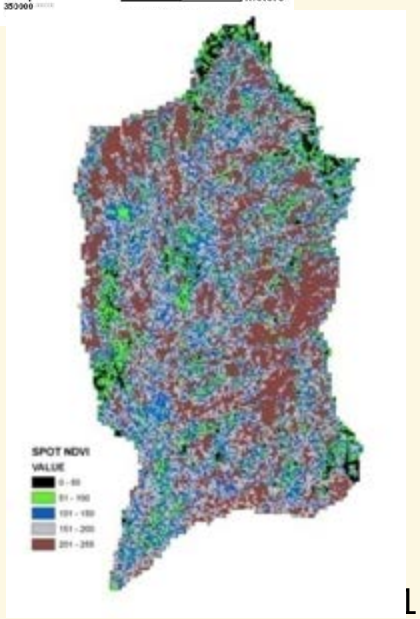
Using SRTM 90m

NDVI from Satellite images

Various number of observations were tested







Testing accuracy using few observations to minimize the field work and maintain accuracy

Percent of observations predicted correctly within ± 50 cm range from field observed soil depth values

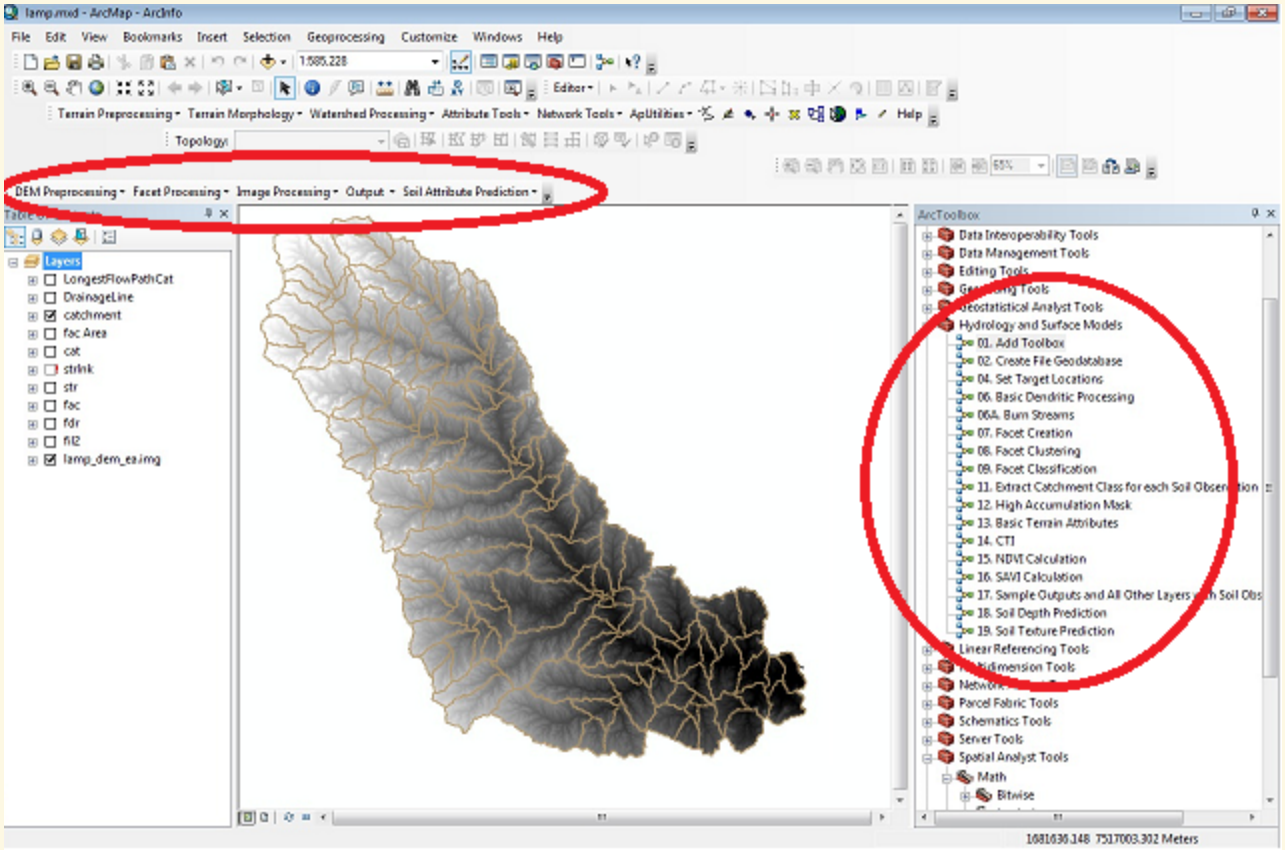
No. of observations used	Percent of predicted observations (%)
180	97.5
150	95
120	92.5
90	87.5
60	87.5
40	72.5
30	67.5
25	65
20	35

Watershed area ~ 60 sq. km

Future

Design user-friendly toolkit to predict soil attributes:

Stand alone OR Sub-model within SWAT (Soil & Water Assessment Tool)

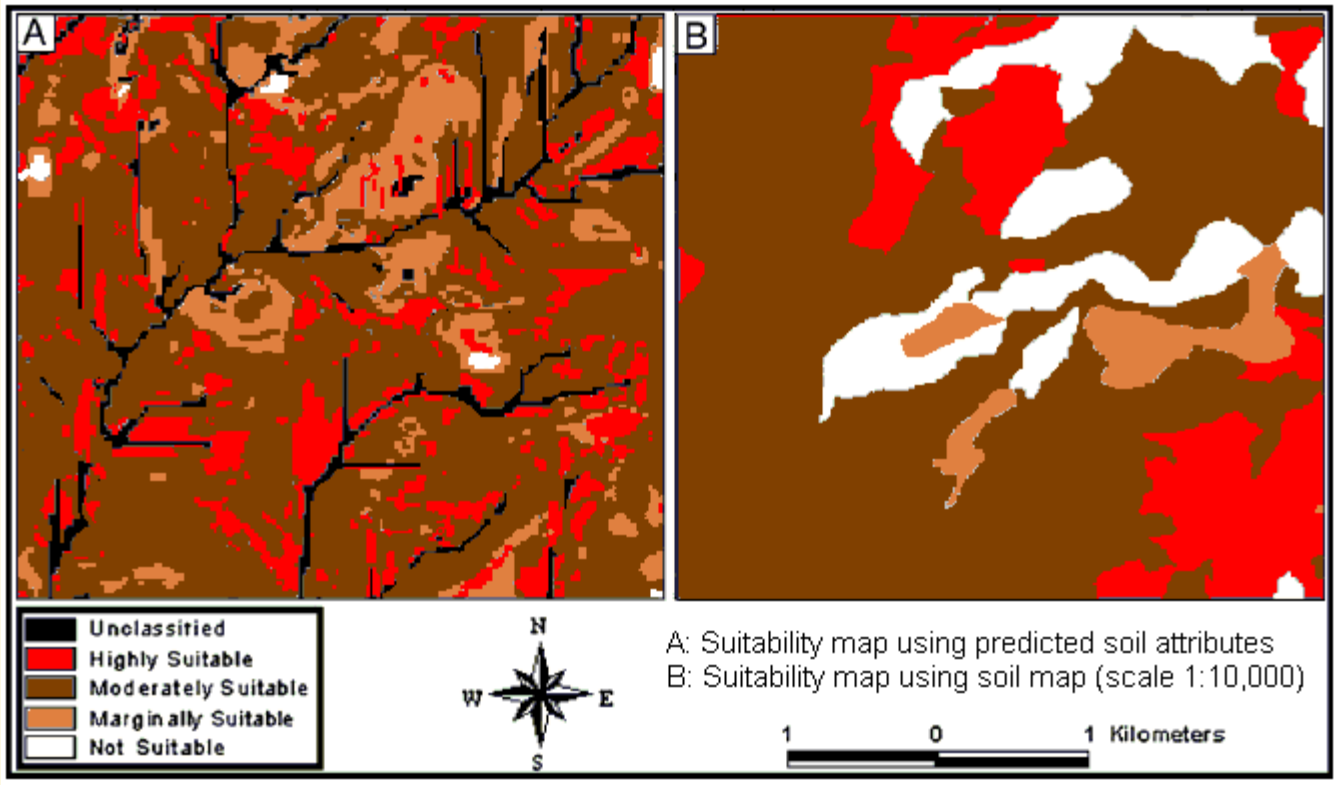


Encourage applications at various levels and purposes with minimum input from the field

Example of application: suitability analysis

Accuracy of the suitability classification derived from predicted soil attributes is comparable with those derived from traditional 1:10,000 soil maps

Spatial distribution of suitability classes derived from the predicted soil attributes indicated more realistic pattern



Example of application: using SWAT to investigate the impact of various SLM options

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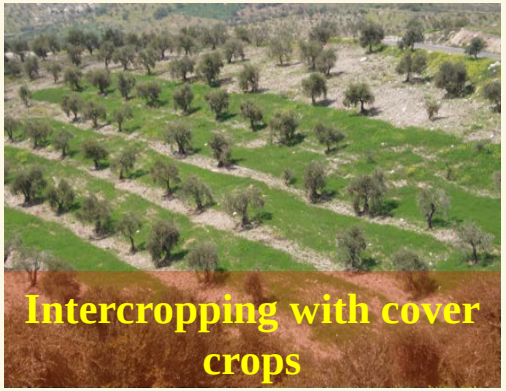
Participatory implementation of SLM:

Contour Stone bunds (continuous)

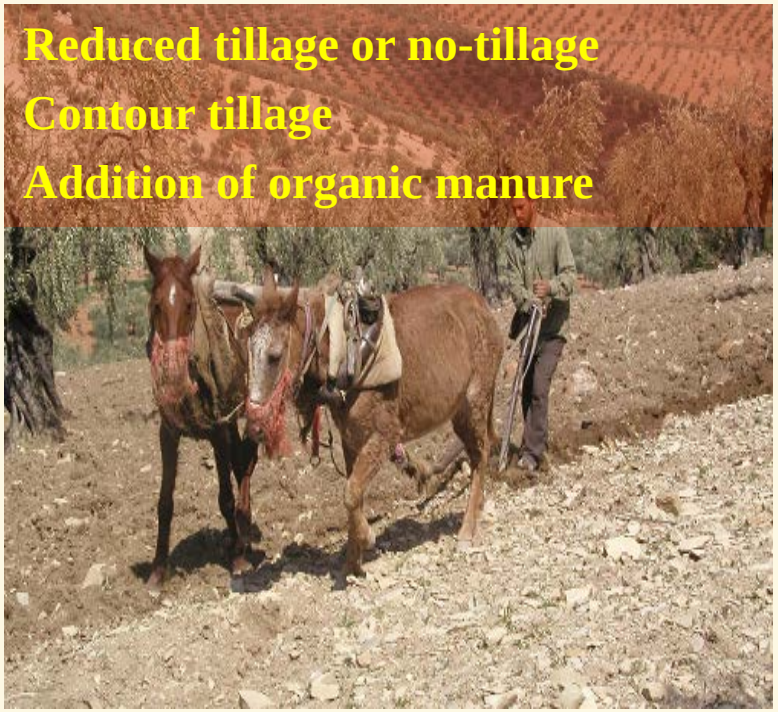
Semi-circular stone bunds



Intercropping with cover crops

Valerrani system (intermittent pits)

Continuous contour ridges



Reduced tillage or no-tillage
Contour tillage
Addition of organic manure

SWAT help in developing scenarios for sustainable land management

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Monitoring of runoff, sediment loss, and soil nutrient loss at watershed and field levels to Combat land degradation

Concluding remarks

Similarity and suitability analysis, soil-landscape and environmental modeling are promising tools to cope with soil management challenges

Provide means to facilitate within and among countries collaboration to provide regional coverage of data and information needed for sustainable soil management

Yet, long way to go …

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Thank You …