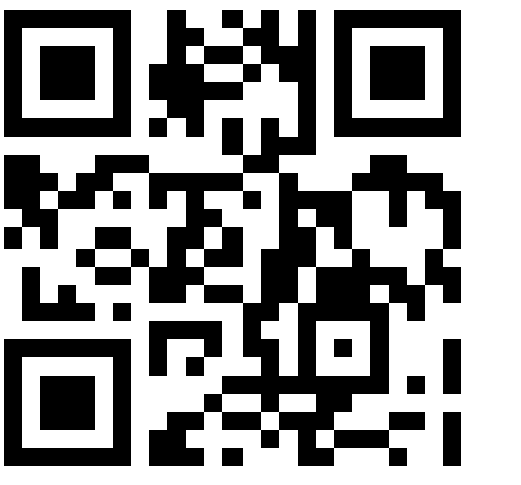




Managing quantifiable uncertainties in digital land suitability assessments



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One can derive with digital soil and climate modeling, very attribute specific mapping, making it possible to derive quite complex land resource assessments and enterprise suitability frameworks. While the suitability assessment framework design has not really progressed much more from the land evaluation guidelines prepared by the Food and Agriculture Organization of the United Nations (FAO, 1976), it is clear the suitability assessment approach is enhanced by the developments in digital soil mapping practice.

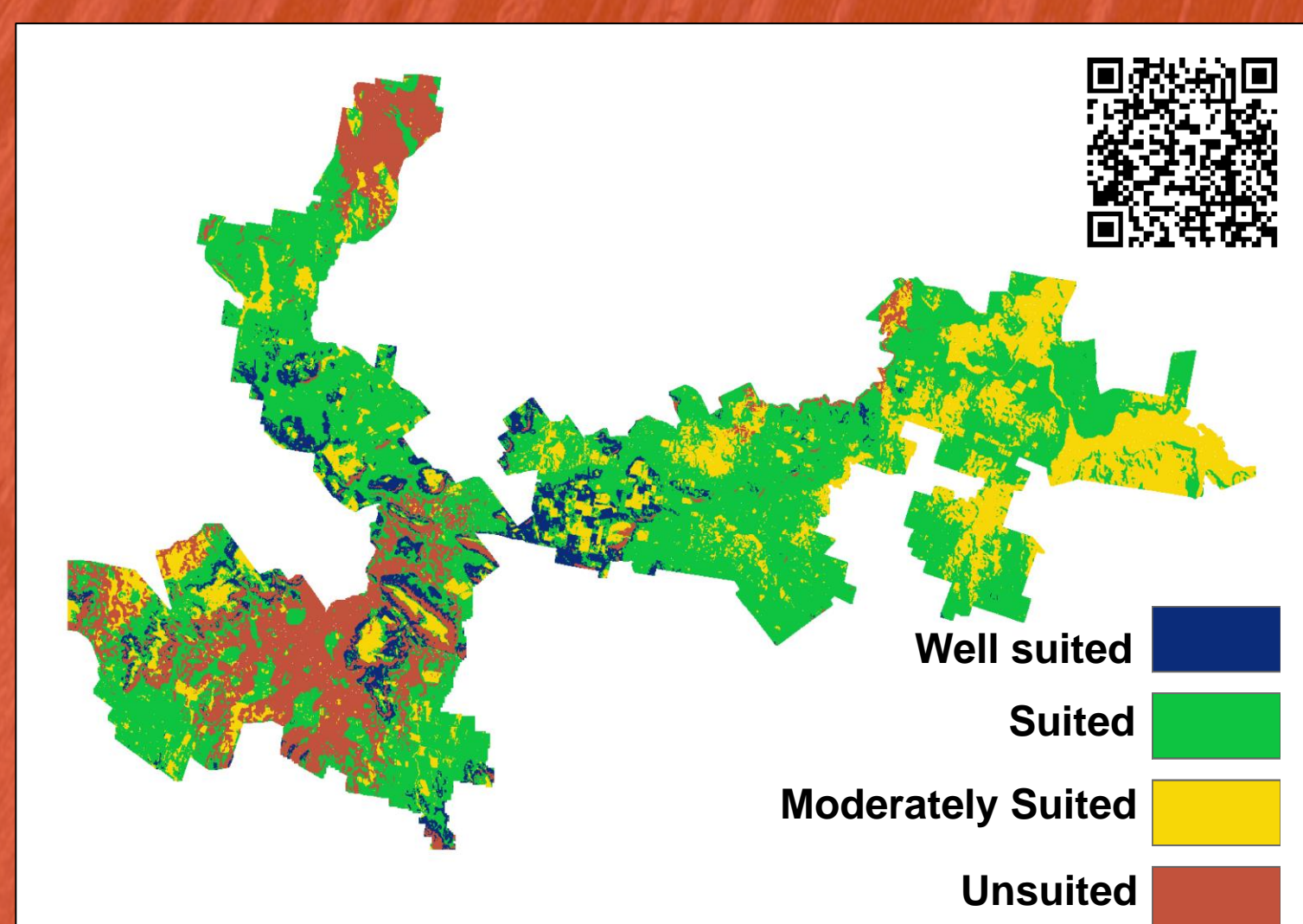
The table below is a suitability matrix developed by the Tasmanian Government for assessing the suitability of **Hazelnut** production throughout the state on the basis of soil and climatic data.

Crop	Soil Depth	Depth to sodic layer	pH of top 15cm (H ₂ O)	EC (top 15 cm)	Texture (top 15cm - % clay))	Drainage	Stoniness (top 15cm)	Frost	Mean max monthly temp	rainfall	Chill hours
W	>50cm		5.5-6.5	<0.15dS/m	10-30%	Well, Moderately well	<10% ≤ 2 (>200mm)	No days < -6 deg C in June, July or Aug – occurs 4/5 years	Mean Jan or Feb max temp – 20-30°C	<50mm (mean March)	Chill hours 0-7° C (April-August inclusive): >1200
S	40-50cm		5.5-6.5	<0.15dS/m	30-50%	Imperfect	10-20% ≤ 3 (>200mm)	No days < -6 deg C in June, July or Aug – occurs 3/5 to 4/5 years	Mean Jan or Feb max temp – 30-33°C & 18-20°C	<50mm (mean March)	Chill hours 0-7° C (April-August inclusive): 600 - 1200
MS	30-40cm		6.5-7.1	<0.15dS/m	30-50%	Imperfect	10-20% ≤ 4 (>200mm)	No days < -6 deg C in June, July or Aug – occurs 2/5 to 3/5 years	Mean Jan or Feb max temp – 33-35°C	<50mm (mean March)	Chill hours 0-7° C (April-August inclusive): 600 - 1200
U	<30cm		<5.5 >7.1	>0.15dS/m	>50% or <10%	Poor, Very poor	>20% ≥ 4 (>200mm)	No days < -6 deg C in June, July or Aug – occurs <2/5 years	Mean Jan or Feb max temp – >35°C & <18°C	>50mm (mean March)	Chill hours 0-7° C (April-August inclusive): <600

Taking account of the uncertainties provide a realistic and fair appraisal of enterprise suitability.

A naïve analysis...

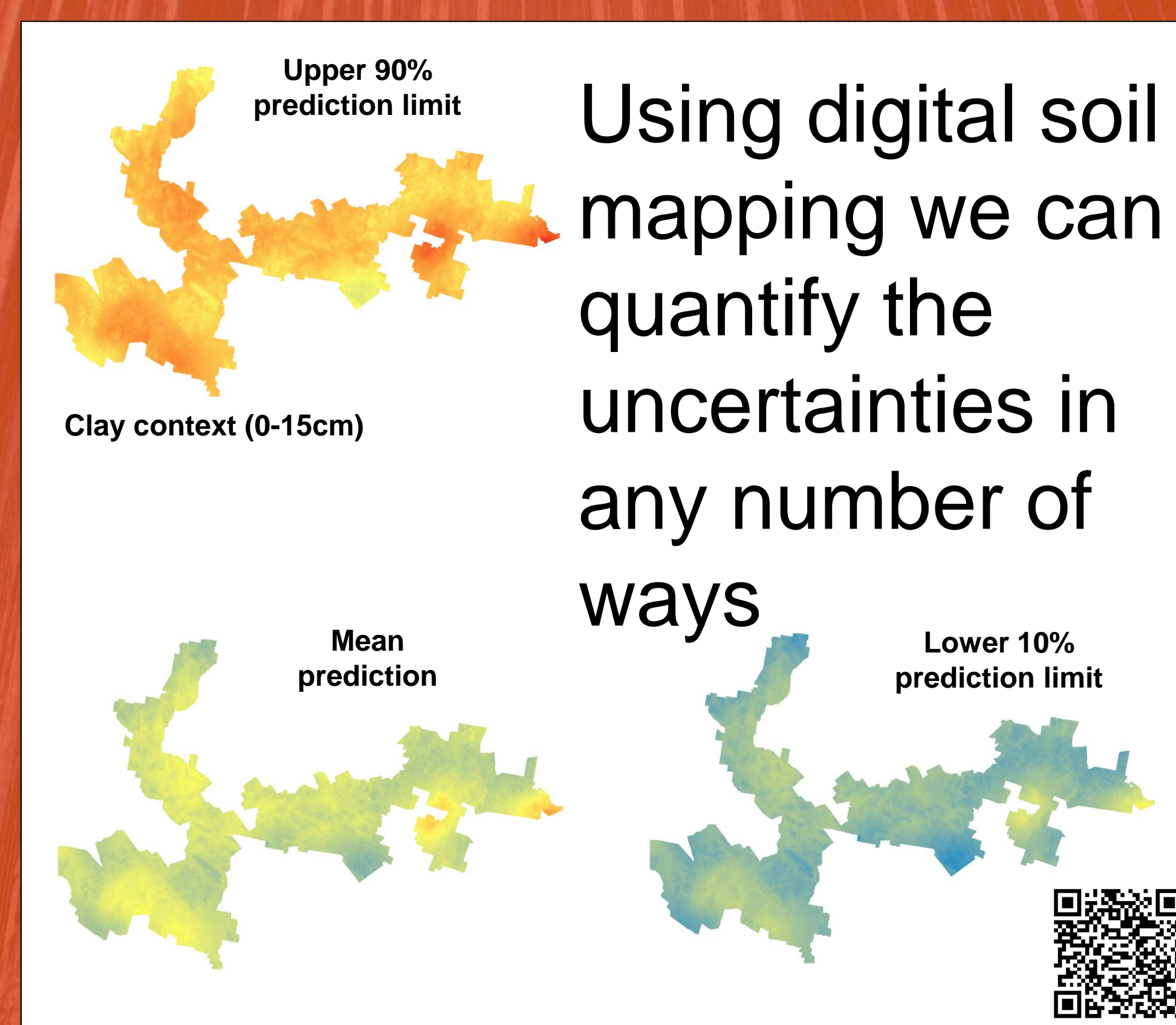
1. Derive digital maps for each of the variables for the table above
2. Encode the suitability criteria in a GIS or similar program
3. Make assessment of suitability using the most limiting factor approach



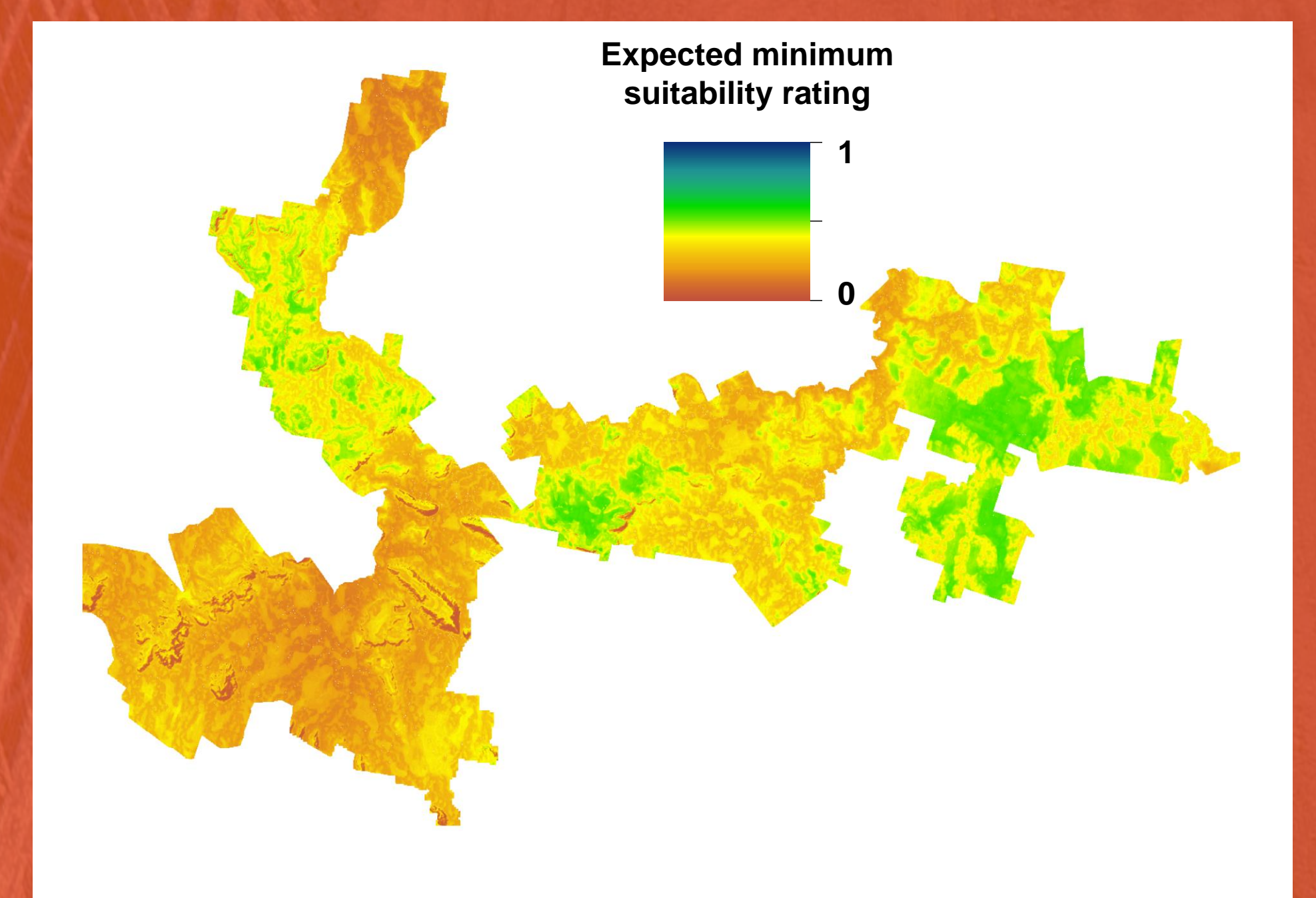
The above analysis assumes all our suitability variables and threshold criteria are error free!

Incorporating quantifiable uncertainties

Uncertainty in suitability variables



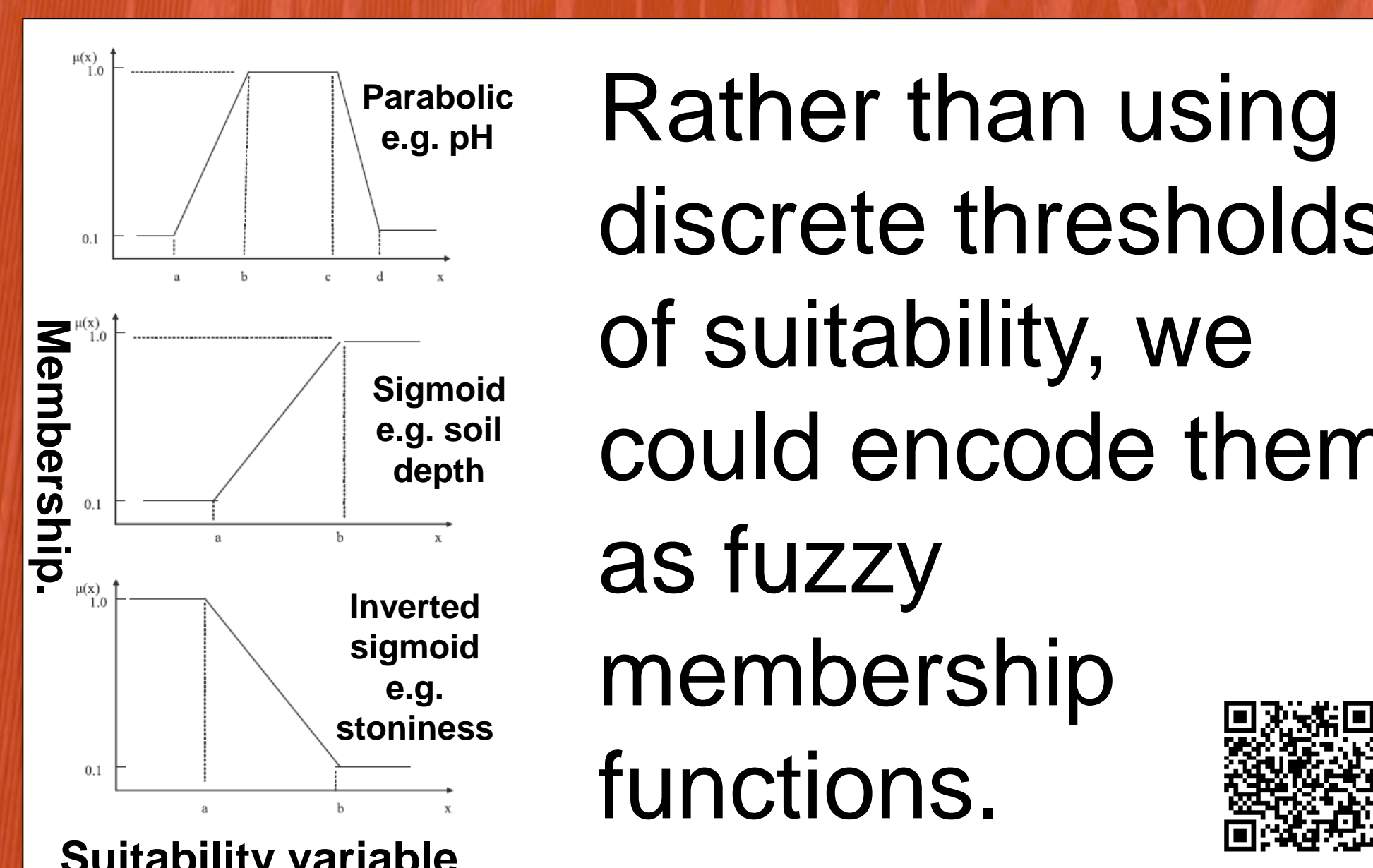
Using digital soil mapping we can quantify the uncertainties in any number of ways



An honest analysis...

1. Embed an uncertainty analysis into the digital mapping of suitability variables.
2. Encode suitability threshold criteria as a group of fuzzy membership functions.
3. Run suitability analysis via simulations by exploring the uncertainty space of the suitability variables.

Uncertainty in threshold criteria



Rather than using discrete thresholds of suitability, we could encode them as fuzzy membership functions.