Testing Land Resource Area Concepts

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Introduction

The NRCS's Land Resource Regions (LRRs), Major Land Resource Areas (MLRAs) and Land Resource Units (LRUs) are used to guide programs and practice applications based on geographical areas where resource concerns, problems, or treatment needs are similar. While the art and science of resource area mapping has advanced significantly in the past several decades, the NRCS's regionalizations have typically lacked suitable quantitative foundations in defining resource area concepts.

With the recently adopted provisional Ecological Site initiative (intended to complete initial inventory of ES in the contiguous U.S. by 2020), a pressing need has arisen to stratify ES concepts by practical and functional resource areas. Because resource areas (LRRs, MLRAs, and LRU), are rarely discrete physical entities—often being conceptualizations reflecting perceived biases from the mappers—it is important that resource areas implement rule-based procedures to test concepts and geography. Here we present a methodology suitable for testing resource area geography and provide two case studies from the Desert Southwest and in the Central United States.

Principle Environmental Covariates	NRCS Land Resource Hierarchical Framework	
CLIMATE, PHYSIOGRAPHY	Land Resource Region	Land Resource Region
CLIMATE, PHYSIOGRAPHY	Major Land Resource Areas	Major Land Resource Areas
CLIMATE, PHYSIOGRAPHY, GEOLOGY, LANDFORM	Land Resource Units	Land Resource Units
GEOLOGY, LANDFORM, VEGETATION, SOILS	STATSGO General Soil Map	Ecological Sites Groups
GEOLOGY, LANDFORM, VEGETATION, SOILS	SSURGO Detailed Soil Map	Ecological Sites
VEGETATION, SOILS	Component	
VEGETATION, SOILS	Soil Pedon	Patch

Methodology

Resource area boundaries were tested using a ranked-order model of local MLRA components (climate, geology, physical geography, soil, and land use) from existing MLRA boundaries in relationship to regional data. We then used a dimensionality reduction method to transform spatial models of elevation, climate, water balance, geology, soil properties, and phenology into a single grid and performed the similar analysis. Modeled geographic resource areas were tested against the 2006 MLRA boundaries through contingency table and cross tabulation using Cohen's K coefficient for determining model agreement. Cohen's K is given as:

[1] $$\kappa = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

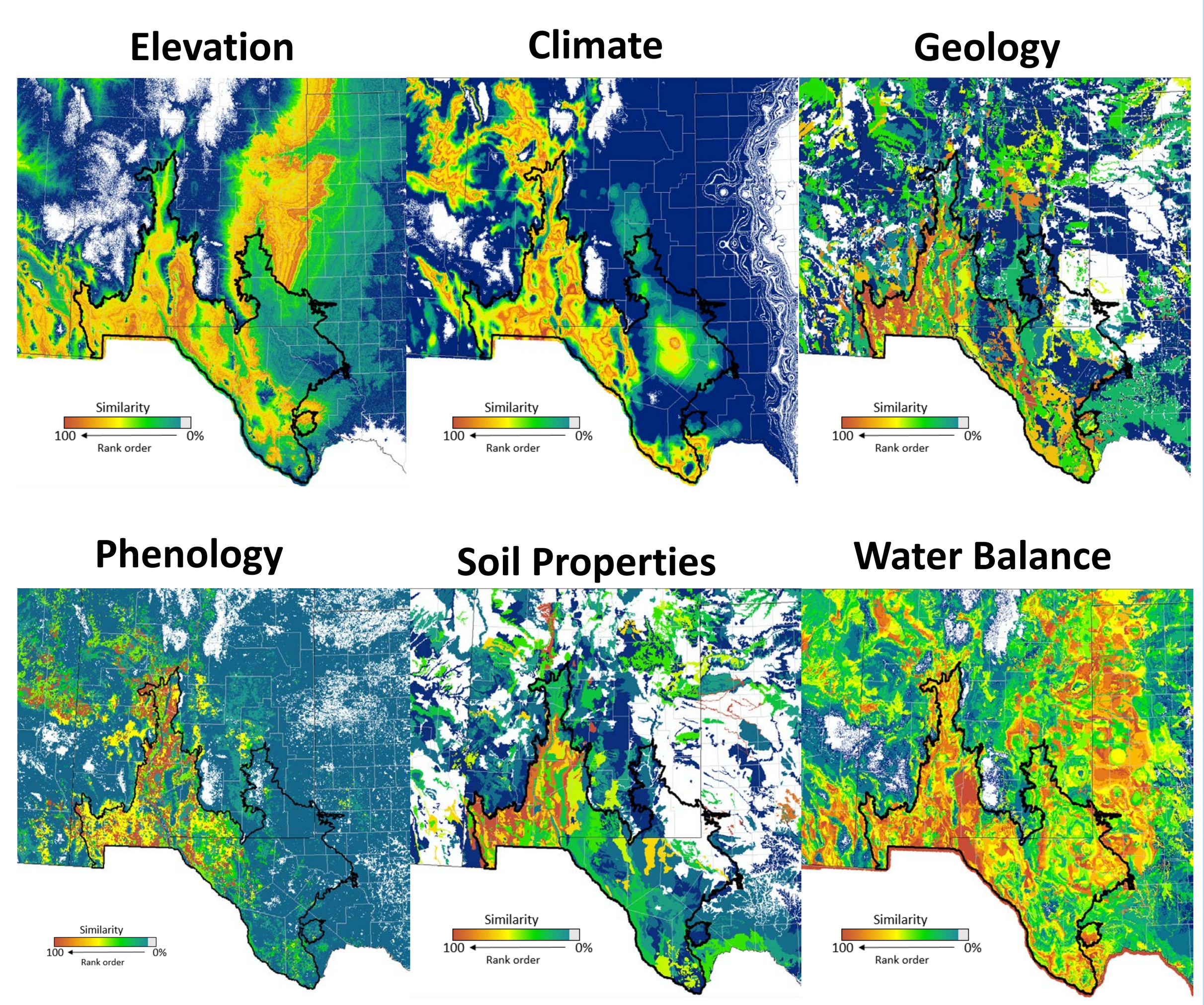
[2] $$\Pr(e) = \left(\sum \frac{n_i}{n} + \frac{m_i}{n}\right)$$

where Pr(a) is observed proportionate agreement, Pr(e) is the probability of chance agreement [1]. Pr(e)is calculated from the land area agreement between the two maps [2].

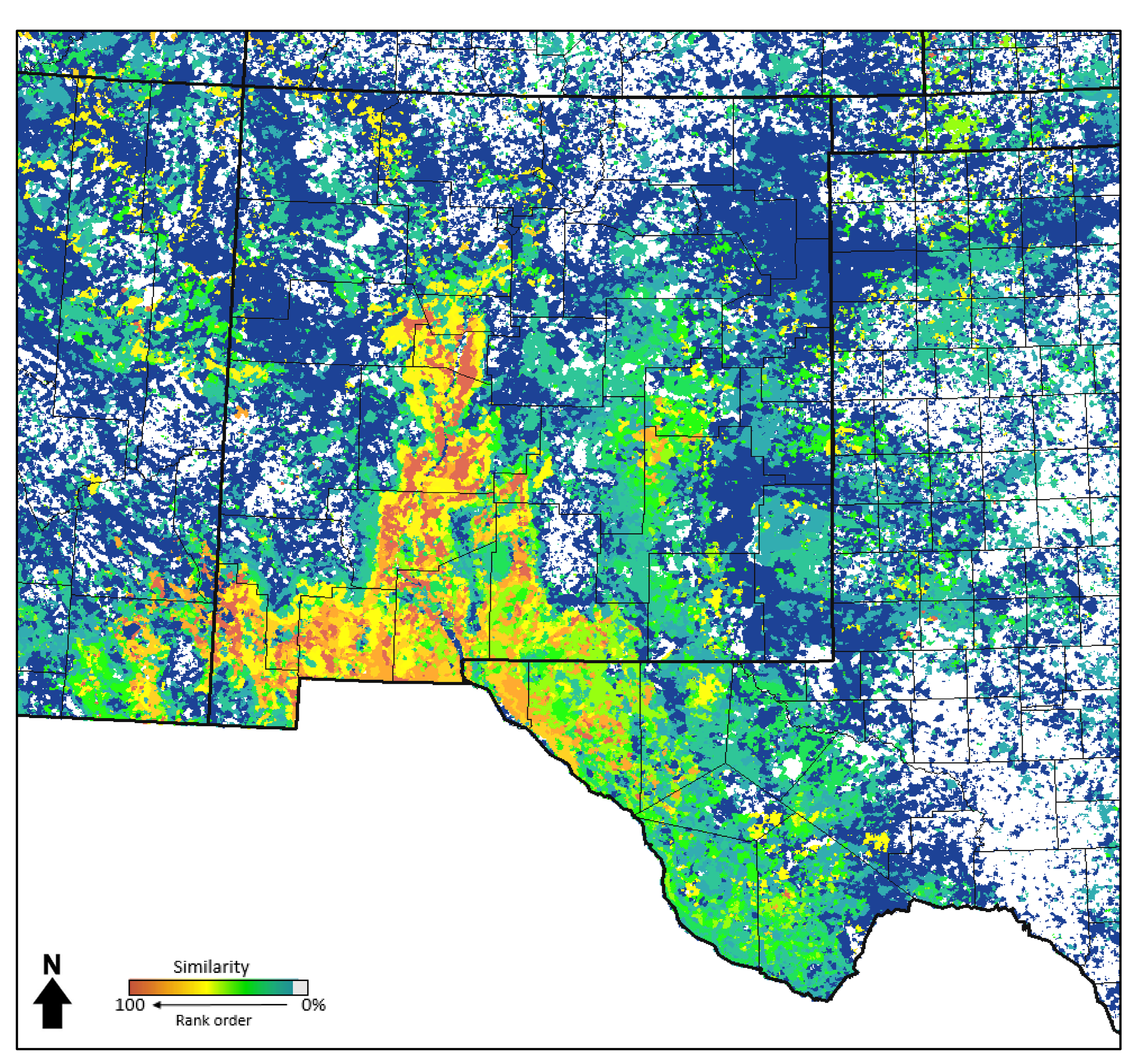
Results

MLRA 42: Southern Desert

MLRA 42: Southern Desertic Basins, Plains, & Mountains is commonly known as the Chihuahuan Desert. MLRA 42 is one of the largest resource areas in the continental U.S., exhibiting high variability amongst resource area components.



Poor correlation is seen within the existing MLRA 42 resource area amongst the components which are defined by large variations in elevation, lithology, and phenology.

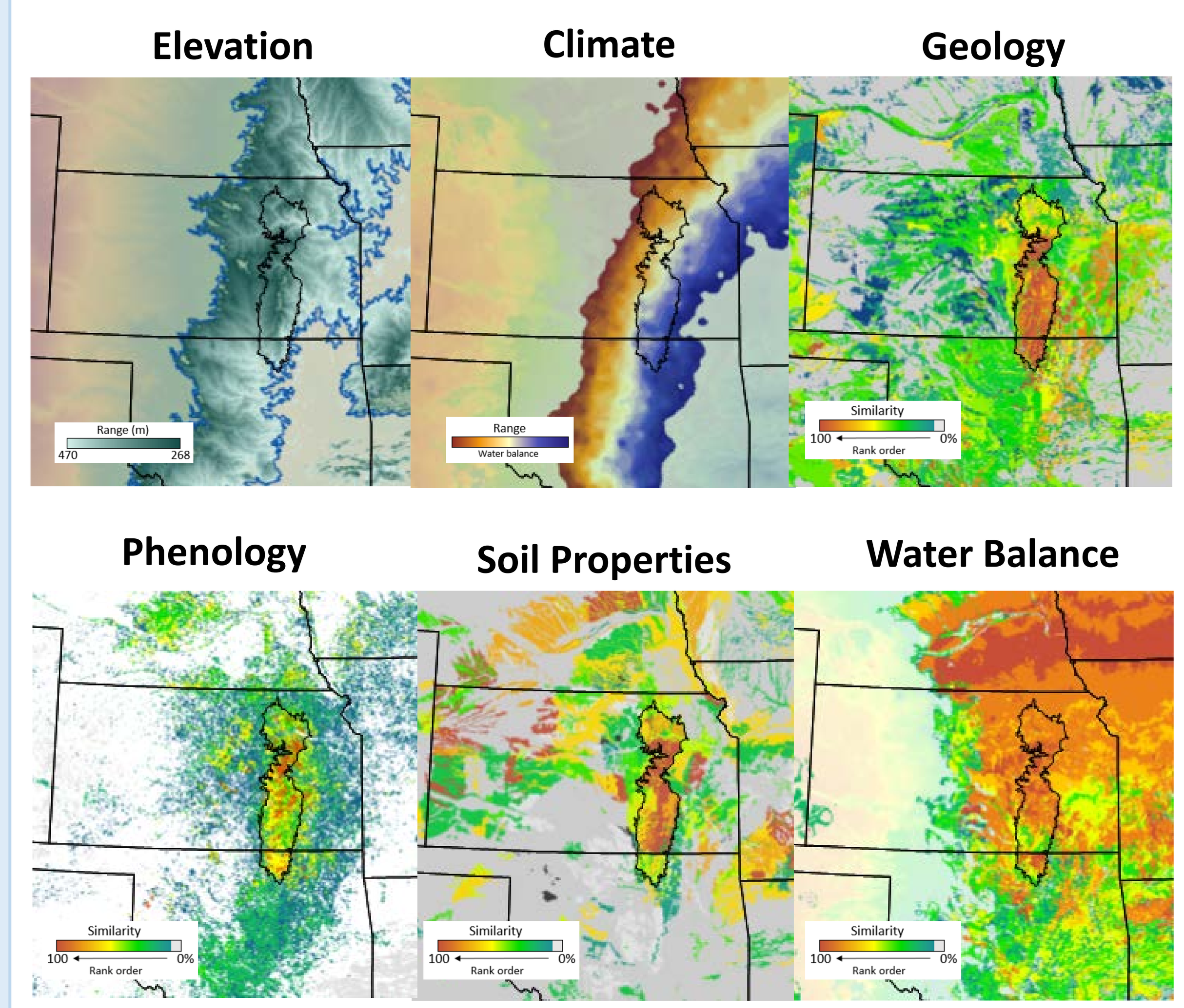


Overall ranked similarity of MLRA 42 concepts to the surrounding region incorporating all component models.

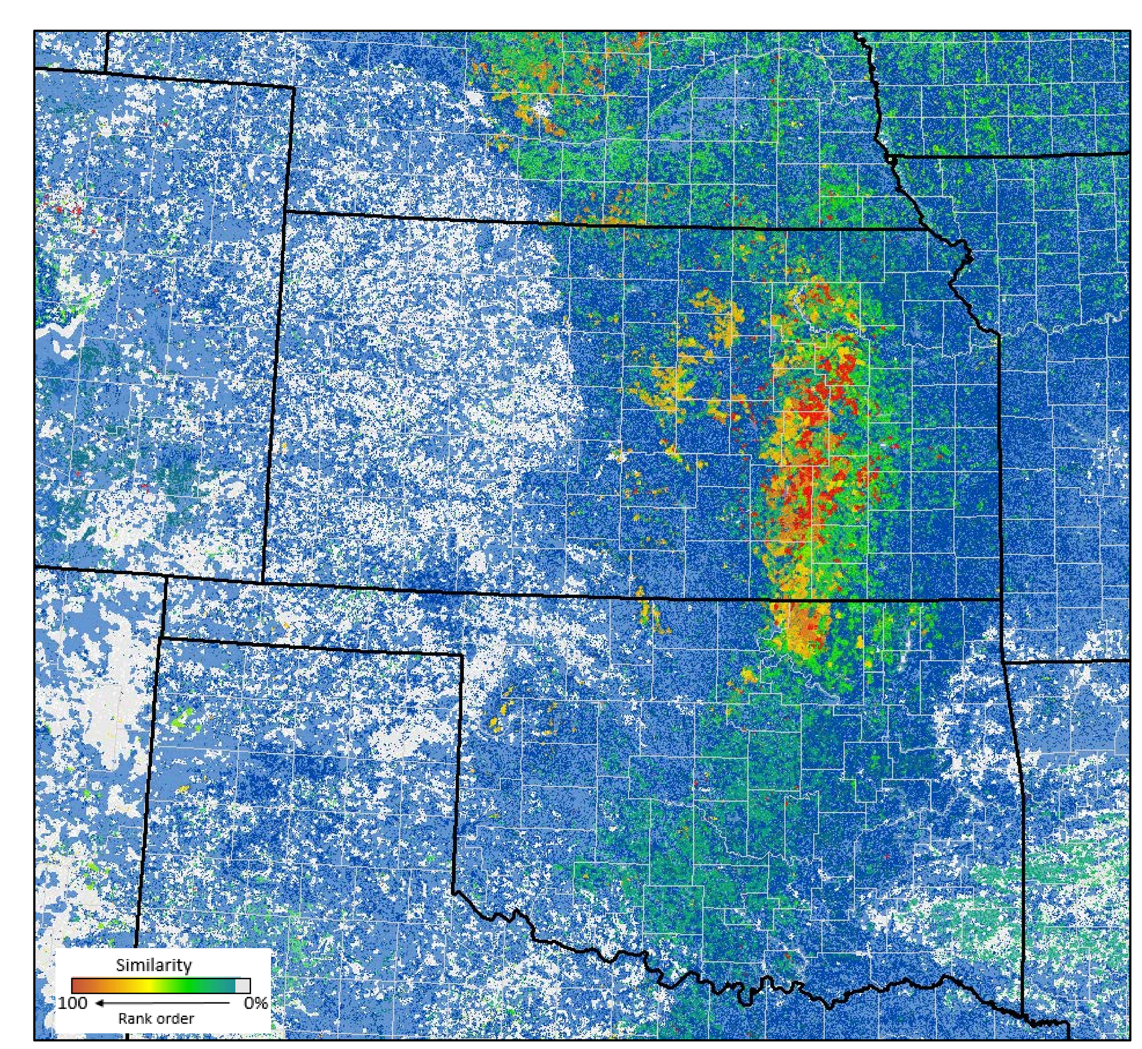
Results

MLRA 76: Blue Stem Hills

MLRA 76: Blue Stem Hills, is commonly known as the "Flint Hills". This resource area typically has uniform shallow soils, chert (flint) rich limestone bedrock close to the surface, and relatively homogeneous vegetation.



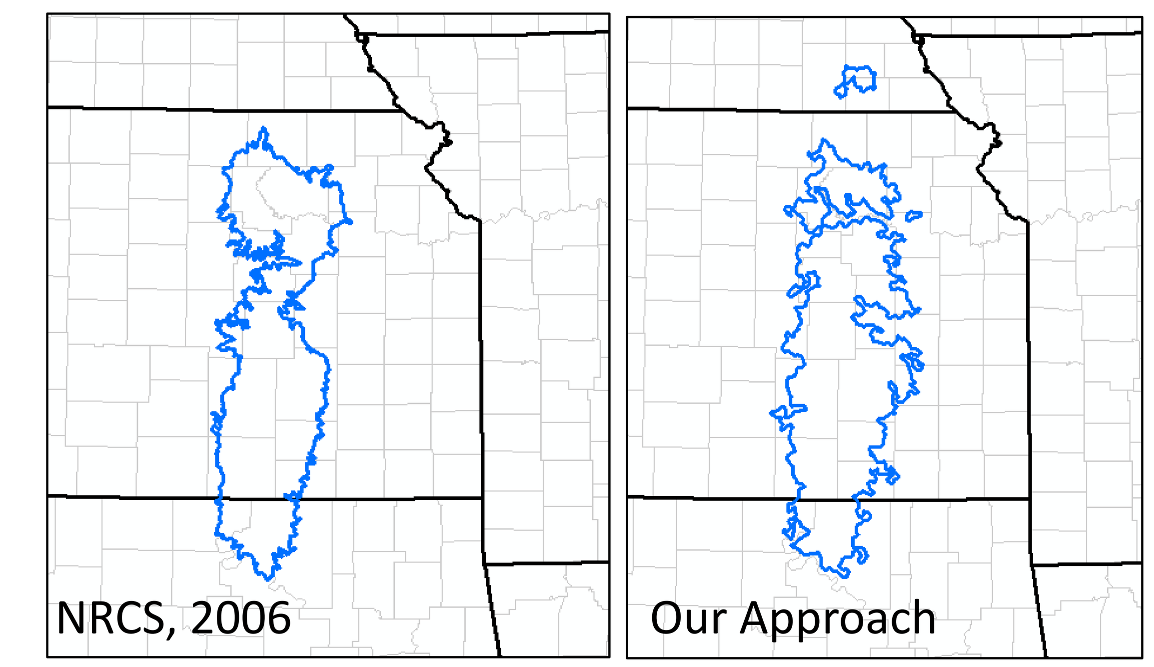
MLRA 76 demonstrated more compact resource area geography between lithology, soil properties, and pheonology with less geographic certainty in climate and elevation.



Overall ranked similarity of MLRA 76 concepts to the surrounding region incorporating all component models.

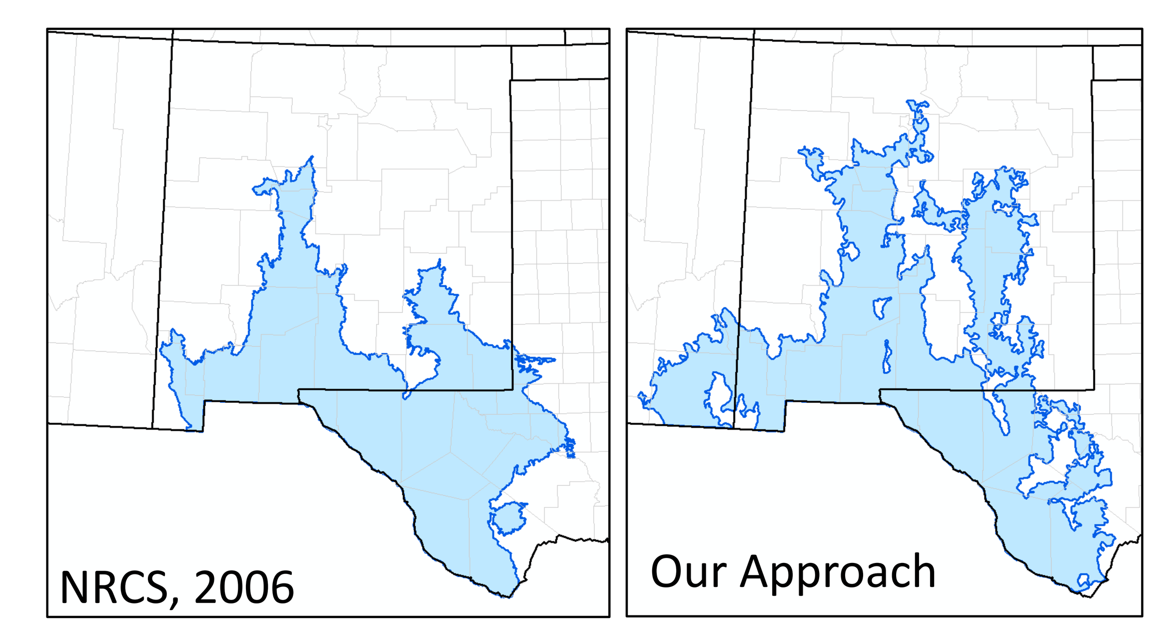
Resource Area Comparisons

Resource area boundaries were clipped using an 85% threshold based on transformed models (center bottom). "Very good" agreement (κ = 0.8127) was shown for MLRA 76, while only "moderate agreement" (κ = 0.5667) demonstrated for MLRA 42.



MLRA 76 (Units in x 100 ha)		2006 Map yes	2006 Map no
Our Results	Yes	19924	378
Our Results	No	6109	6487

Agreement = 88.3%, κ = 0.8127



MLRA 42 (Units in x 100 ha)		2006 Map Yes	2006 Map No
Our Results	Yes	12007	3871
Our Results	No	6294	22362

Agreement = 77.2%, κ = 0.5667

Conclusions

While a national effort is underway to update NRCS's Land Resource Regions, Major Land Resource Areas, and Land Resource Units, soil scientists and ecologists require tools to define resource areas in order to stratify local ecological site concepts. Here we explore a simple method to test resource area boundary concepts through a data oriented approach based on the historic regionalizations.

Map Resource:

USDA-NRCS, 2006, Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, USDA Agriculture Handbook #296.