Remote Sensing Argali Habitat in Tajikistan Mountains

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Project in Tajikistan

Image credit: USGS

- Surrounded by:
  - Kyrgyzstan → North
  - Uzbekistan → West
  - China → East
  - Afghanistan → South

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- Tajikistan is the poorest country in Central Asia
- 60% of the population (~8 million in 2013) is dependent on agriculture
- Total area ~ 52,251 mi^2 (New Mexico = 121,590 mi^2)
- Mountainous with >50% of the country is above 9,800 ft
- $Elev_{max}$ = 18,000 ft (5,510 m): Highest elevations are located in the eastern region
- Pasture is 21% of the land use

Project in Tajikistan

Credit: Safari.com

- Unique eastern Pamir Mountains.
- Wild ungulates include Marco Polo argali (*Ovis ammon*)
- Considered the longest-horned species of wild sheep
- 8649 count in summer 2009
- 45 hunting permits are issued yearly at a cost of $40,000 per permit.

- Grazing competition on pastures between wild ungulates and livestock – causing overexploitation of pastures
- Dwarf shrubs becoming overused → decrease in vegetation cover *(Breckle et al., 2006)*

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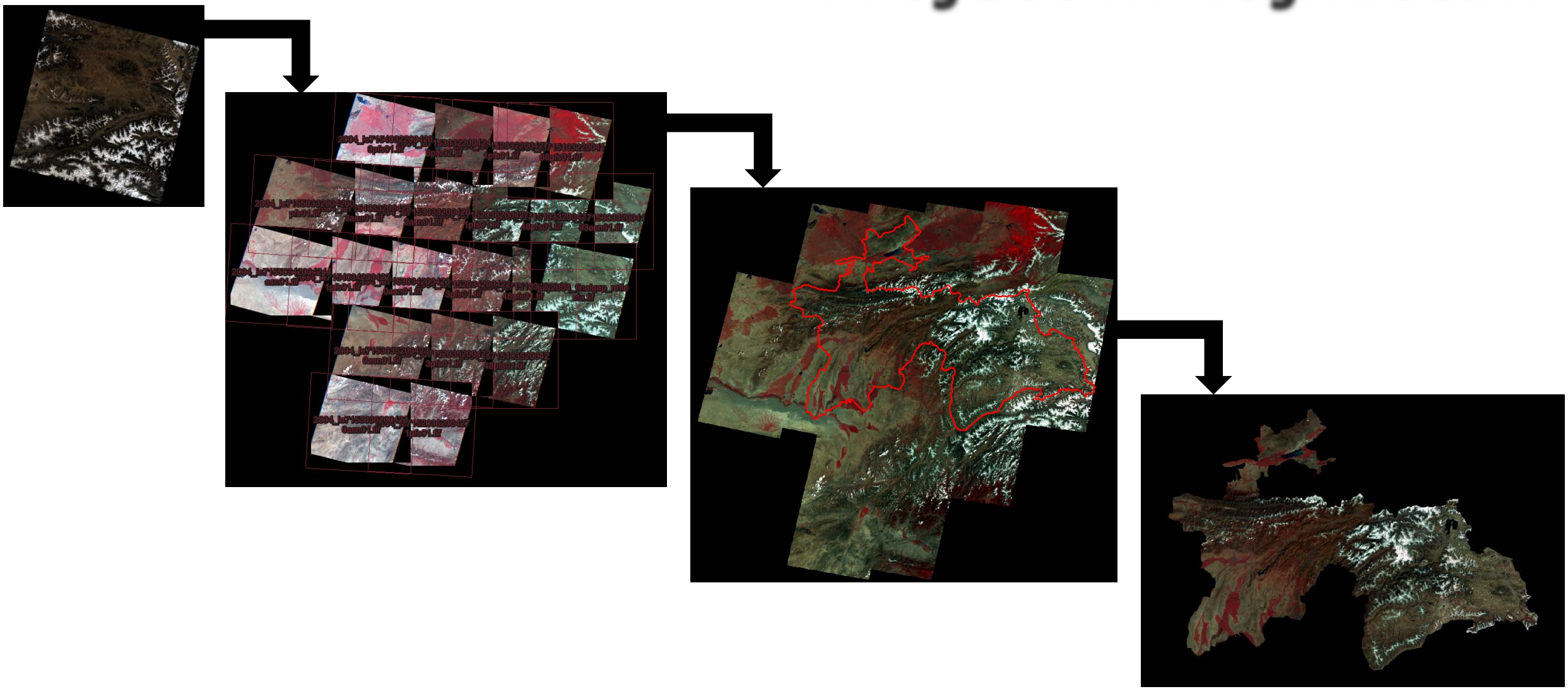

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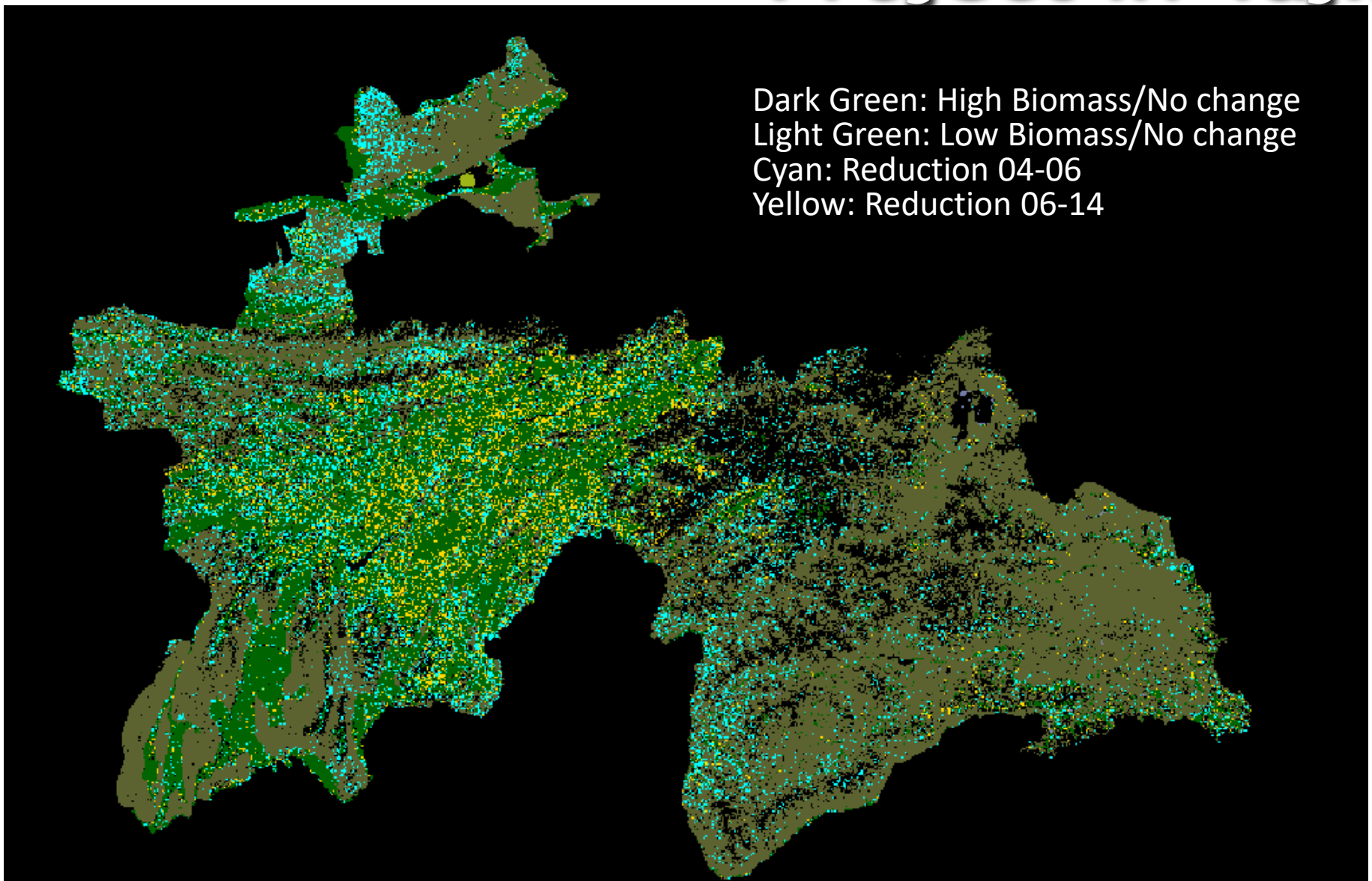

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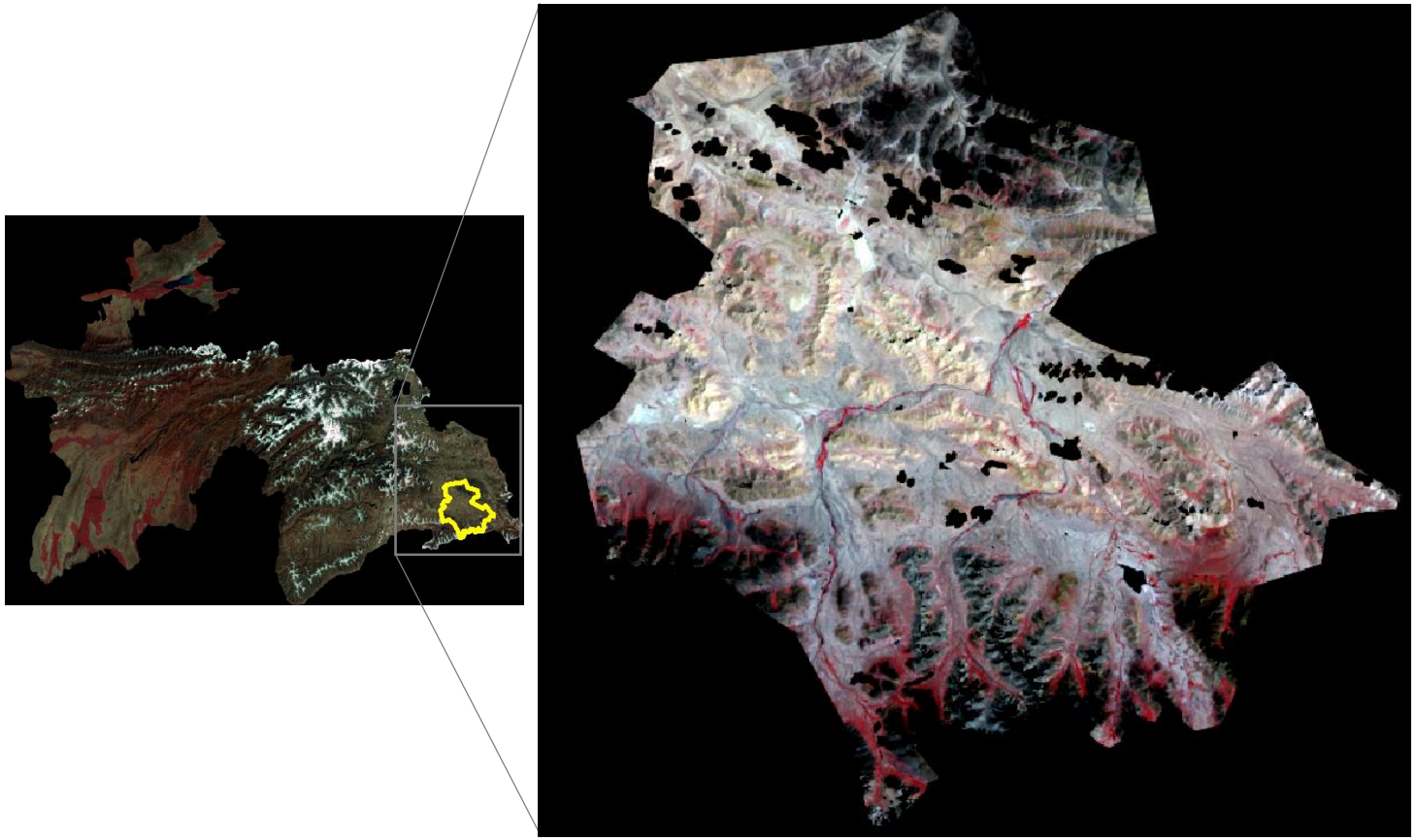

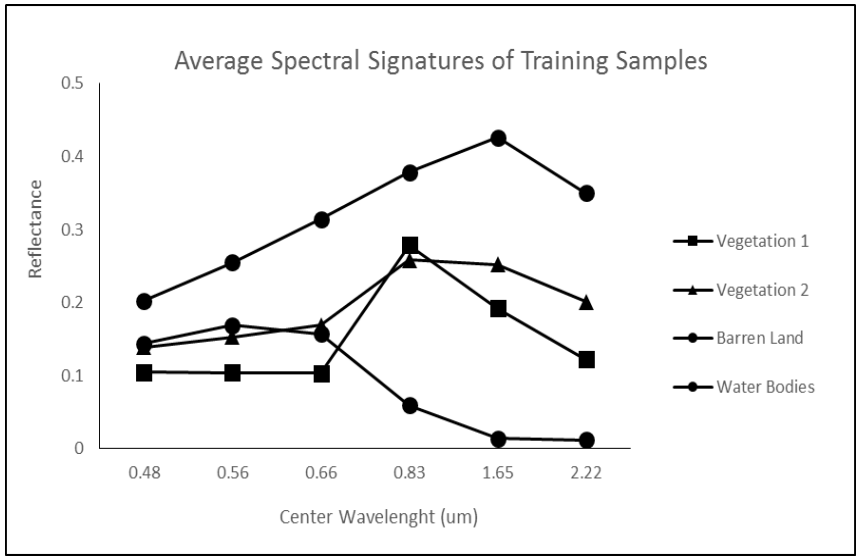

Choice of classes were grounded on:

1. Objective of the research
2. Expected certain degree of accuracy in the image classification
3. Easy identification of the classes on the Landsat and QuickBird images

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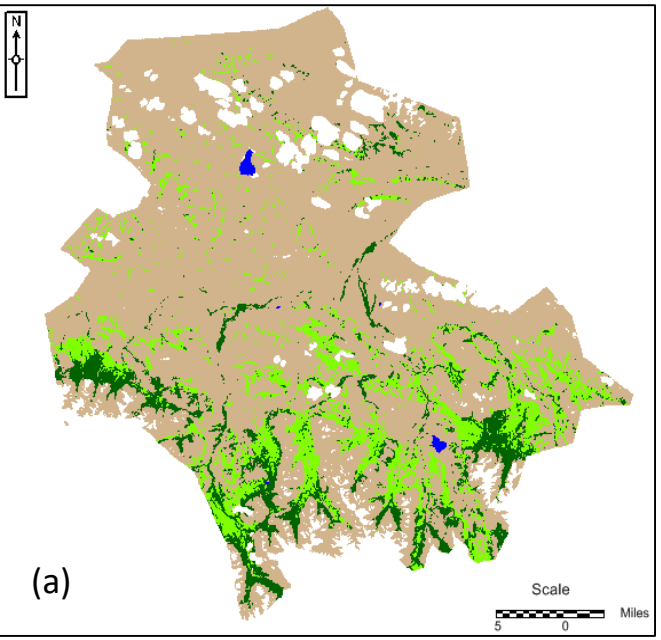

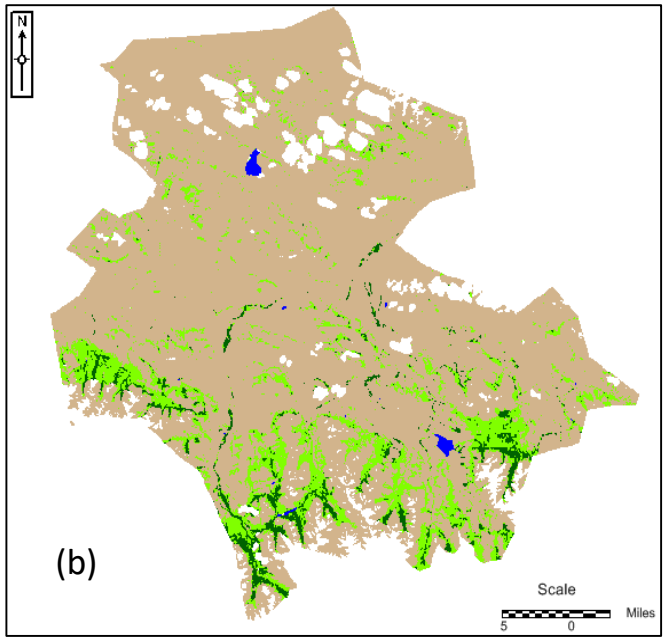

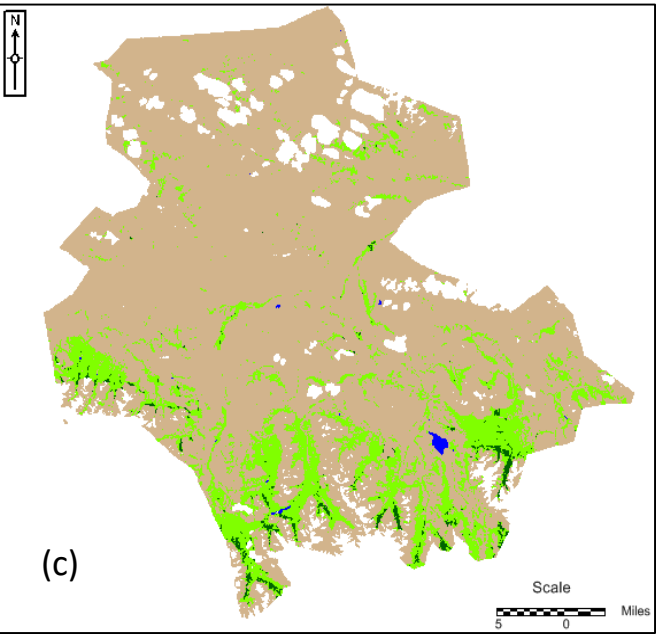

Vegetation-1
Vegetation-2
Water Bodies
Barren Land

Classification maps of Landsat TM+ for (a) July 2004, (b) July 2006, and Landsat 8 OLI for (c) July 2014, showing the four major classes analyzed in this study.

Class	Area (ha)		
	2004	2006	2014
Vegetation-1	18,358.7	6,872.2	2,137.5
Vegetation-2	26,719.5	25,605.4	29,310.8
Water Bodies	529.2	687.0	387.5
Barren Land	177,622.2	190,065.0	191,393.8
Total	223,229.6	223,229.6	223,229.6

- Vegetation-1 class decreased by 62.6% from 2004 to 2006 and decreased by 68.9% from 2006 to 2014.
- That's 88.4% decrease in areal proportion for the past decade.
- Barren land has been increasing in area since 2004. A 7.8% increase was observed in the last 10 years.
- Overall, vegetation-1 class has shown the most change in terms of area among the four classes considered.

Change Matrix

2004-2006	2004			
2006	Vegetation-1	Vegetation-2	Water Bodies	Barren Land
Vegetation-1	33.8	1.0	0.2	0.2
Vegetation-2	47.7	44.4	0.1	2.8
Water Bodies	0.0	0.0	98.0	0.2
Barren Land	18.5	54.6	1.7	96.8

2006-2014	2006			
2014	Vegetation-1	Vegetation-2	Water Bodies	Barren Land
Vegetation-1	27.6	0.8	0.0	0.0
Vegetation-2	69.7	74.7	0.5	3.9
Water Bodies	0.0	0.0	52.1	0.0
Barren Land	2.7	24.5	47.4	96.1

2004-2014	2004			
2014	Vegetation-1	Vegetation-2	Water Bodies	Barren Land
Vegetation-1	11.0	0.0	0.0	0.1
Vegetation-2	74.4	51.0	0.2	2.2
Water Bodies	0.0	0.0	42.8	0.0
Barren Land	14.6	49.0	57.0	97.7

- Net loss of vegetation-1 is much higher than the turnover.
- Decade of change for vegetation-1, only 11% has been retained, the rest changed to vegetation-2 (74.4%) and barren land (14.6%).
- Increase of vegetation-2 areas came mainly from turnovers of vegetation-1 in the 10-year period.

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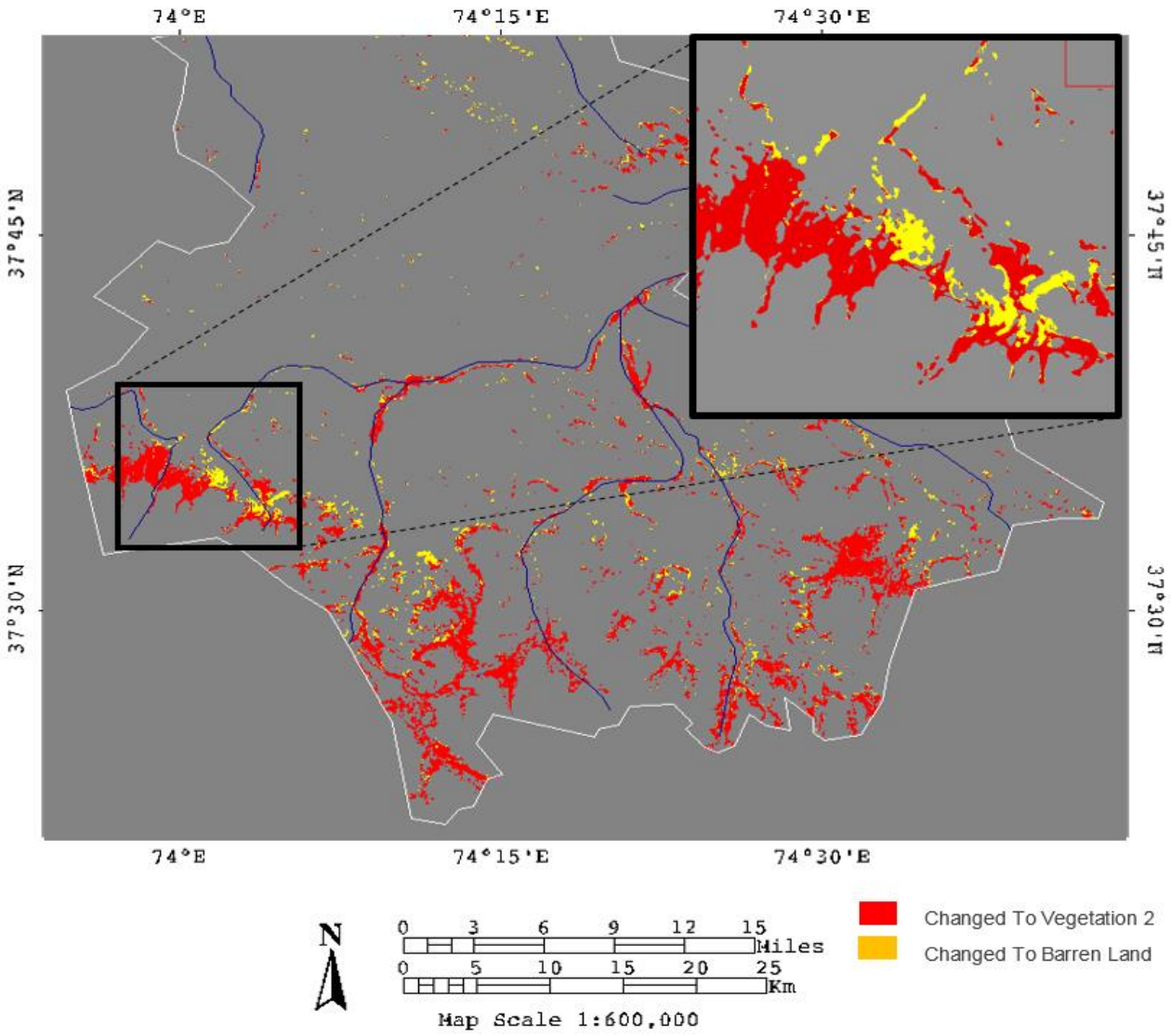

- Change map for the period 2004 to 2014 showing the conversion of the vegetation-1 to vegetation-2 and to barren land.
- Changes occurring in slopping areas and near streams.

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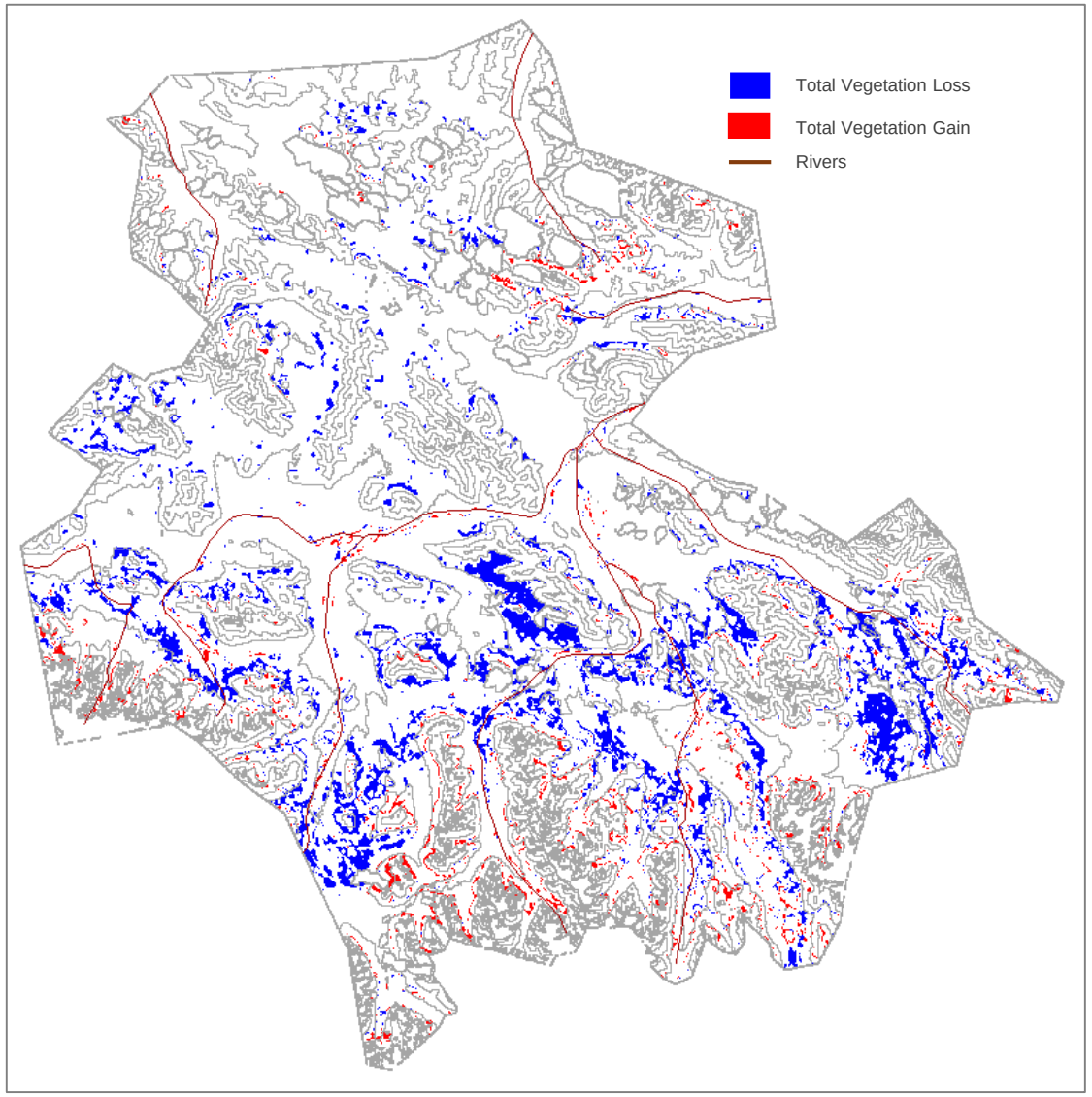

- Close to 15,000 ha of total vegetative cover were lost between 2004 and 2014.
- Over the period of ten years, the overall increase of vegetation area was a little over 4,000 ha.
- Most of the gains are located in the southern region, which consists of higher elevations.
- *Important: Vegetative cover has shown a general trend in fragmentation and actual loss in the periods analyzed in this study.*

Confusion Matrix

Class	Producer Accuracy (%)	User Accuracy (%)	Overall Accuracy (%)	Kappa Statistics (Khat)	Overall Kappa Statistics
2004					
Vegetation-1	82.6	92.7	86.2	0.89	0.81
Vegetation-2	83.3	78.9		0.71	
Water Bodies	93.3	100.0		1.00	
Barren Land	90.9	81.1		0.75	
2006					
Vegetation-1	82.4	97.7	85.4	0.96	0.80
Vegetation-2	91.2	77.5		0.70	
Water Bodies	86.7	100.0		1.00	
Barren Land	83.3	78.1		0.72	
2014					
Vegetation-1	92.5	94.9	90.4	0.92	0.87
Vegetation-2	86.7	89.6		0.86	
Water Bodies	93.8	100.0		1.00	
Barren Land	89.7	81.3		0.75	

- How good are the maps?
- Use QuickBird and WorldView-2 images (2003 to 2013).

- PA is error of omission.
- UA is error of commission.

- Classification results for the years 2004, 2006, and 2014 show an overall accuracy of 86.2%, 85.4%, and 90.4%, respectively.

- Vegetation-2 and barren land classes had lower user accuracies for all time periods.

- Khat of 0.7 to 0.85 means very good agreement (Monserud & Leemans, 1992)

Project in Tajikistan

Geographic Layers as Landscape Drivers for the Marco Polo Argali Habitat in the Southeastern Pamir Mountains of Tajikistan

Eric Ariel L. Salas*, Raul Valdez and Kenneth G. Boykin

Salas, E.A.L.; Valdez, R.; Boykin, K.G. Geographic Layers as Landscape Drivers for the Marco Polo Argali Habitat in the Southeastern Pamir Mountains of Tajikistan. *ISPRS Int. J. Geo-Inf.* **2015**, *4*, 2094-2108.

Project in Tajikistan

Using remote sensing techniques and geographic information systems (GIS), we described the sheep habitat in GIS layers.

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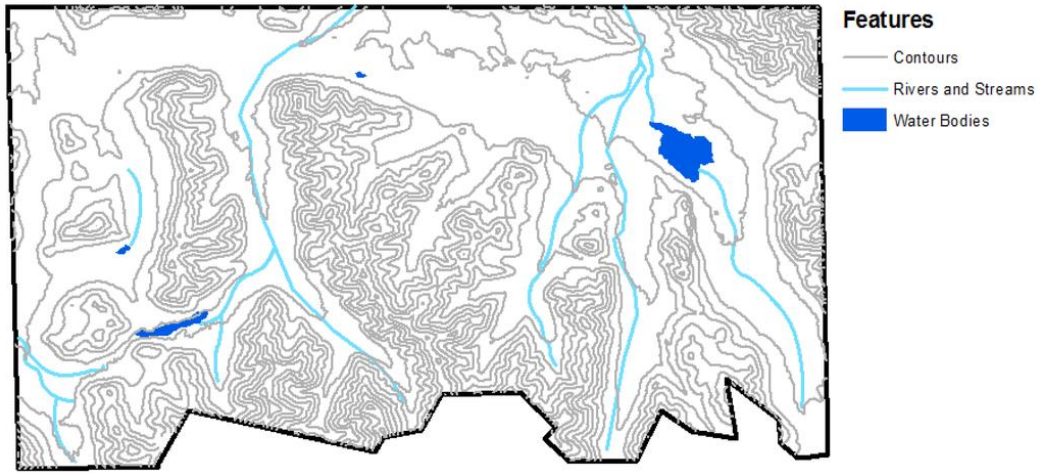
Rivers and Streams Network



Total length of rivers and streams = 92.32 km (57.37 mi)

Of this length, 38.83 km (24.13 mi) were from two major rivers.

Water Bodies

The area of the largest lake located in the northeast region of the study area was about 3.24 km^2 (324 ha).

The rest of the inland water sources had areas that range from 0.08 to 1.04 km^2 (7.8 ha to 104 ha).

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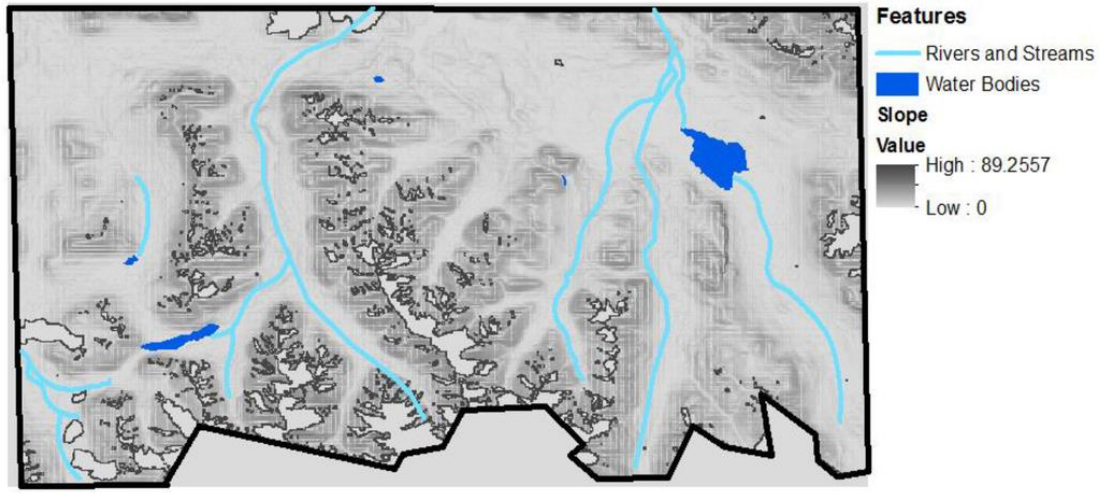
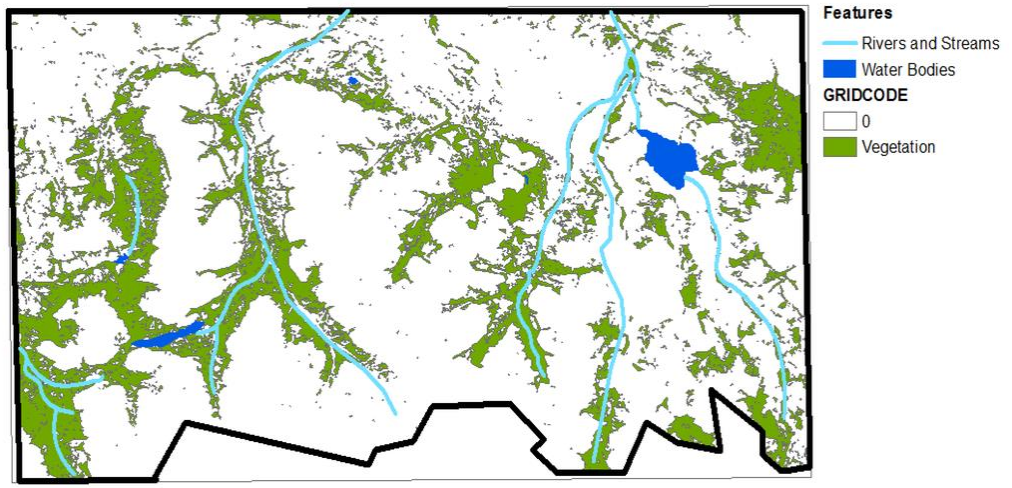
Topography



The maximum degree of slope inclination is 89.26°, while the minimum is 0.27°.

9% of the area was considered very steep, with a slope greater than 80°

Vegetation Cover



More than 80% of the vegetative cover was located within 2 mi from rivers and streams, and within valleys and on foothills.

About 42% of the vegetation was within a distance of 0.5 mi from the river.

A small percentage of vegetation cover (2.3%) thrived 4 mi away from rivers.

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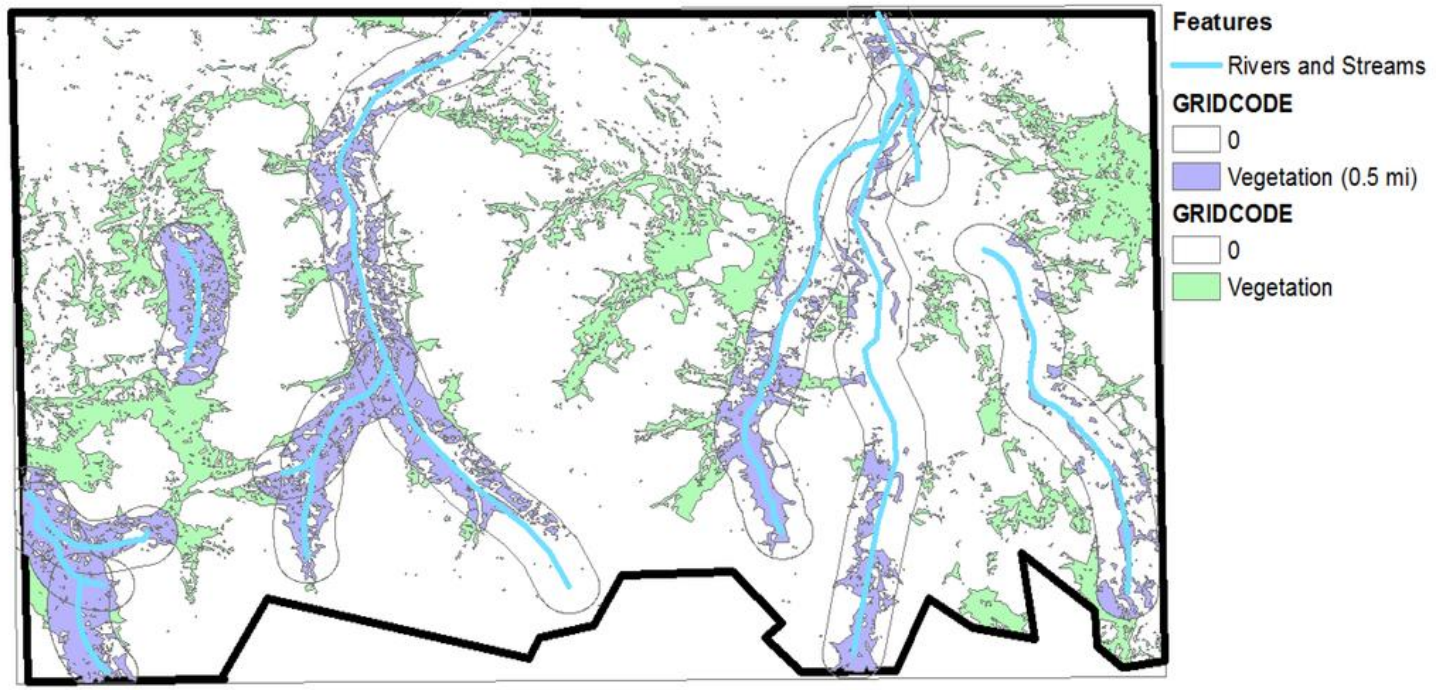

Vegetation cover map of the study area showing the portion of vegetation (42.28%) falling within the 0.5 mi (0.80 km) river buffer zone.

Zones 0.5 mi from the river is from 4200 m to 4700 m (13,780 to 15,420 ft).

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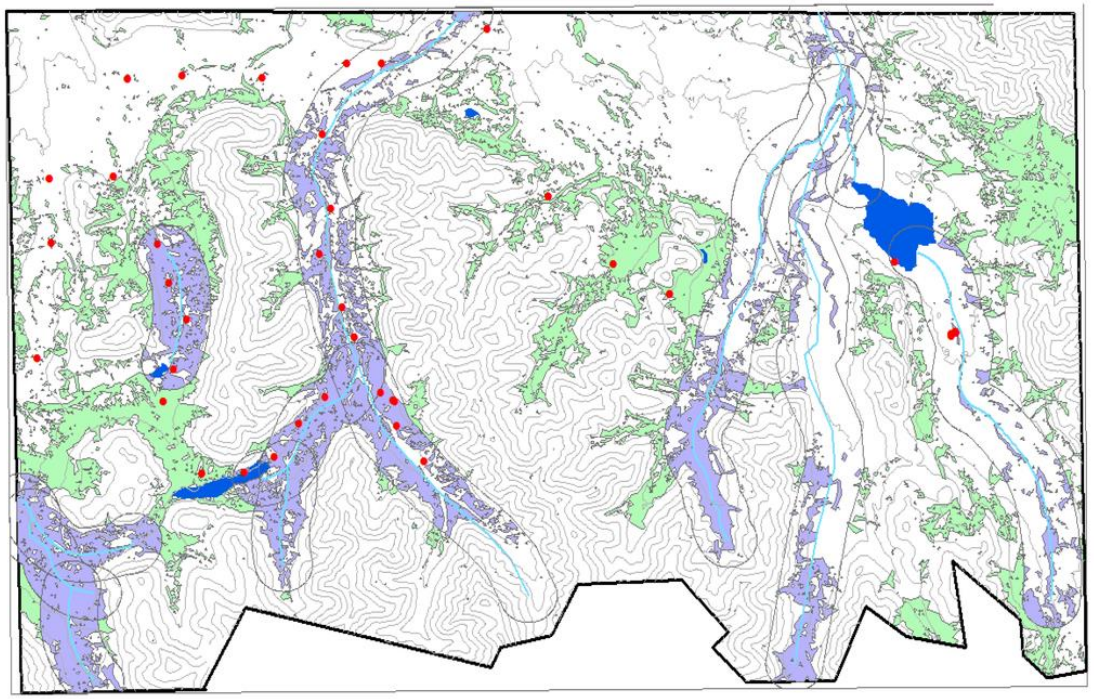
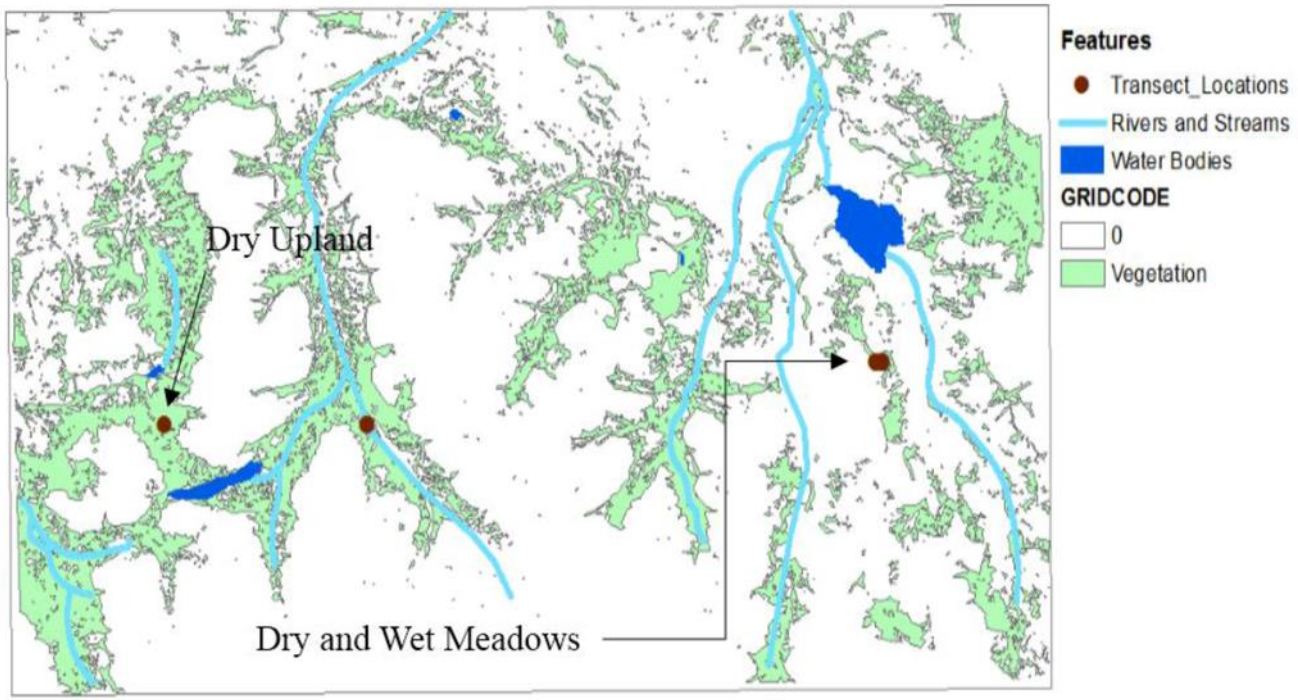
Occupancy of Marco Polo Argali



Wet and dry meadow points



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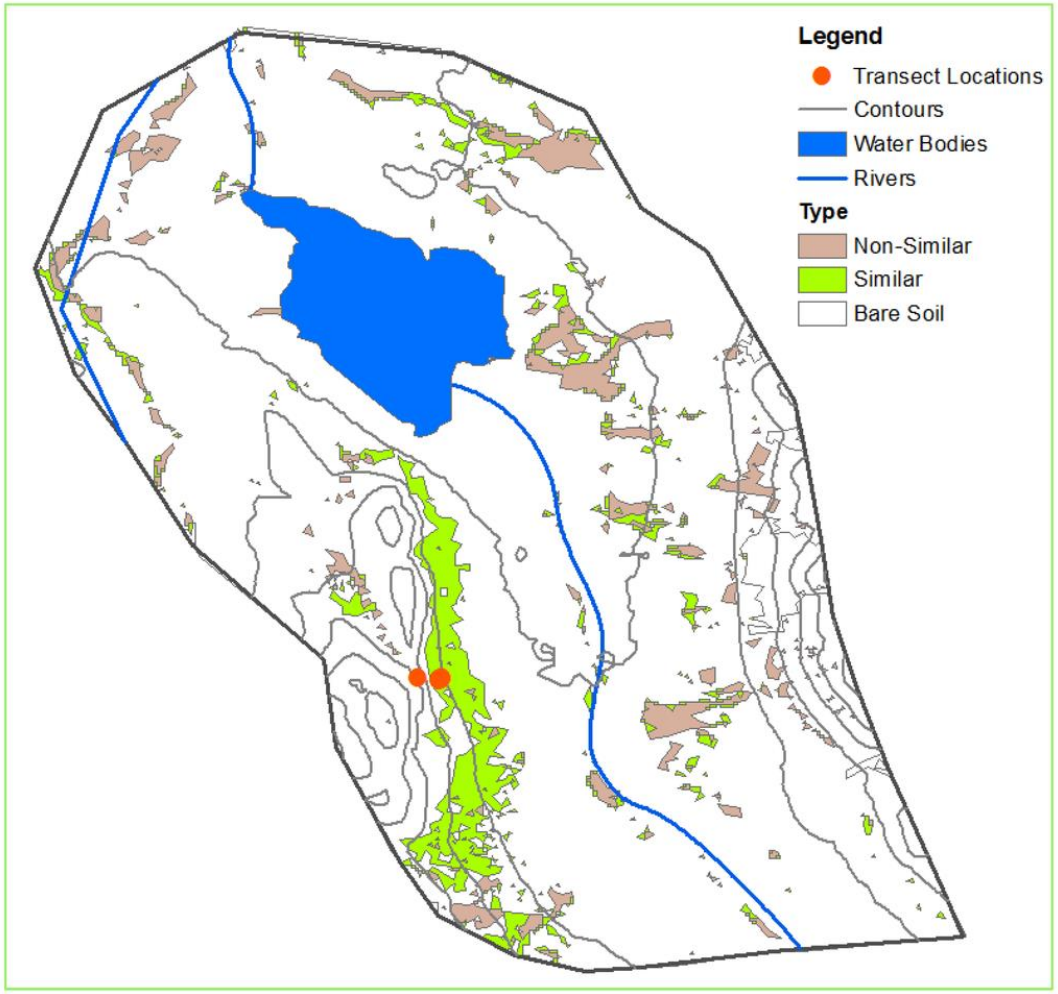

Areas where spectral similarity of the transect communities are found, are labeled “Similar.” The rest of the vegetation cover is labeled “Non-Similar.”

Free Dataset Download: NMSU’s Center for Applied Spatial Ecology (CASE) website (http://case.nmsu.edu/case/tajikistan.html)

Remote Sensing Limitations

- Remote sensing is not a *solution to all difficulties*
- It simply provides *some* of the spatial, spectral, and temporal information about phenomena of interest
- Humans can introduce errors
- Remotely sensed data can be expensive to collect and analyze
- Need for linking ground observations with remote sensing observations (reality check)

Finally, remote sensing is a tool or technique that enables scientific discovery.

References

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