USING GIS AND REMOTE SENSING IN THE STUDY OF THE INFLUENCE OF DROUGHT ON CHANGES IN FOREST COVER AROUND THE ARAL SEA

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https://doi.org/10.5281/zenodo.15258984

Abstract. This study explores the impact of drought on forest cover changes around the Aral Sea using GIS and remote sensing technologies. Satellite imagery from Landsat and MODIS is analyzed to assess the temporal and spatial changes in forest health, revealing significant deforestation, particularly in the southern and eastern parts of the region. The findings highlight the increasing desertification and soil erosion caused by drought, with adverse effects on local biodiversity and ecosystem services. The study underscores the value of GIS and remote sensing in monitoring environmental changes and supporting restoration efforts in the Aral Sea region.

Keywords: Aral Sea, forest cover, drought, GIS, remote sensing, desertification, NDVI, restoration.

The Aral Sea, once one of the world's largest inland bodies of water, has undergone dramatic changes over the past several decades. Once a vast and thriving ecosystem, the Aral Sea has shrunk dramatically due to the diversion of the Amu Darya and Syr Darya rivers for irrigation purposes. This environmental catastrophe has led to a series of ecological consequences, one of the most significant being the drastic reduction of forest cover around the Aral Sea. Drought, a natural occurrence intensified by human activity, has played a key role in this transformation. By utilizing Geographic Information Systems (GIS) and remote sensing technologies, we can now better understand the extent of forest cover loss and the relationship between this environmental change and the increasingly frequent droughts in the region.

The Aral Sea's shrinking has altered the regional climate, leading to higher temperatures and lower precipitation. These climatic changes, combined with human-induced water scarcity, have put enormous pressure on the ecosystems that once depended on the sea's water. Forests around the Aral Sea, particularly

riparian forests, have been hit hardest by this alteration in hydrology. As droughts have become more prolonged and intense, they have caused significant stress on local vegetation, leading to widespread forest dieback [2].

Remote sensing technologies, such as satellite imagery, and GIS tools have provided new opportunities for researchers to study the changes in forest cover around the Aral Sea over time. By using remote sensing data, scientists can monitor vast areas over long periods and detect changes in land cover that may not be immediately visible through traditional ground-based surveys. These tools also enable the analysis of spatial and temporal patterns in vegetation health and forest cover, offering valuable insights into how drought has impacted the area [5].

Satellite data, particularly from Landsat and MODIS satellites, allows for the observation of land cover changes over time. These satellites take images of the Earth's surface at regular intervals, enabling researchers to compare forest cover at different times and assess the impact of drought on these ecosystems. By analyzing these satellite images in conjunction with climate data such as rainfall and temperature, researchers can identify correlations between drought periods and changes in forest cover.

One of the key tools used to assess vegetation health is the Normalized Difference Vegetation Index (NDVI), which uses satellite imagery to measure the density and health of vegetation. A drop in NDVI values in the Aral Sea region would indicate a decrease in forest health, which can be attributed to water stress caused by drought conditions. Using GIS, these NDVI values can be mapped over time, creating visual representations of forest cover loss. This enables researchers to identify specific areas where drought has had the most significant impact and to track how these areas have changed over time [1].

The results of this analysis reveal a clear and troubling trend: the forest cover around the Aral Sea has diminished drastically over the last few decades. Areas that were once lush with vegetation are now barren, with only scattered patches of surviving trees. The loss of forest cover has been most pronounced in the southern and eastern parts of the Aral Sea Basin, where the effects of water depletion and drought are most severe. This transformation is not only a consequence of natural droughts but also of the region’s water management practices, which have reduced the water supply for local ecosystems.

The reduction in forest cover has had a cascading effect on the local environment. Forests provide vital ecosystem services such as soil stabilization, carbon sequestration, and habitat for wildlife. The loss of forest cover has led to

increased soil erosion, particularly in areas where the vegetation once held the soil in place. As a result, desertification has become a growing problem, with the region's landscape rapidly transitioning from arable land to arid desert.

The effects of drought on forest ecosystems around the Aral Sea are also evident in the decline of local biodiversity. Many species that once depended on these forests for food and shelter are now facing the threat of extinction. This ecological crisis has led to an urgent need for restoration efforts to reverse some of the damage caused by the loss of forest cover. However, such restoration efforts must be carefully planned to take into account the changing climate conditions and water availability.

The use of GIS and remote sensing technologies in this context has been invaluable in tracking the changes in forest cover around the Aral Sea. These technologies provide a detailed and accurate picture of the region's environmental changes, allowing scientists and policymakers to make more informed decisions about how to manage and restore the landscape. However, while remote sensing can provide a wealth of data, it is important to combine these technological tools with ground-based monitoring and ecological studies to gain a comprehensive understanding of the situation.

Addressing the root causes of the environmental degradation around the Aral Sea, particularly the over-extraction of water for irrigation and the changing climate, will require coordinated efforts at multiple levels. Local governments, international organizations, and the scientific community must collaborate to develop sustainable water management practices and initiate large-scale restoration projects. Efforts to restore forest cover must focus not only on replanting trees but also on rebuilding resilient ecosystems capable of withstanding future droughts.

Conclusion. In conclusion, the influence of drought on forest cover around the Aral Sea is a stark reminder of the fragility of ecosystems in the face of both natural and human-induced environmental change. By utilizing GIS and remote sensing, we are able to better understand the extent of the damage and to monitor ongoing changes. However, reversing the environmental damage caused by drought will require a comprehensive approach that combines technological tools with practical solutions aimed at mitigating water scarcity, reducing desertification, and restoring forest ecosystems. The future of the Aral Sea region depends on our ability to adapt to these challenges and take action to protect the remaining ecosystems.

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