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## WATER SURFACE DYNAMICAL CHANGE ANALYSIS OF SUDOCHI LAKE IN ARAL SEA AREA USING REMOTE SENSING INFORMATION

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### Аннотация

Ушбу илмий изланиш тирик мавжудотлар ва экотизим мақсадлари учун муҳим аҳамиятга эга бўлган, Орол денгизи яқинидаги Судочье кўли ер усти сувлари динамикаси таҳлилига бағишланган. Амударёнинг юқори қисмида сувнинг кўп ёки камлигига боғлиқ ҳолда кейинги бир неча ўн йилликлар давомида кўлнинг сув юзаси тез-тез ўзгариб турди. Изланиш учун маълумотлар масофадан зондлаш ёрдамида олинди, хусусан, Landsat сунъий йўлдоши маълумотларидан фойдаланилди. Масофадан зондлаш орқали олинган суратлар 5 йил давомида тайёрланган бўлиб, уларнинг асосий қисмида сув юзасини тўғридан-тўғри назорат қилиш таснифи методи ёрдамида чизилган. Изланиш натижалари Судочье кўли сув юзасининг турли вақтлардаги ўзгаришларини кўрсатади. Бу маълумотлар муҳим қарорлар қабул қилишда шунингдек, ботқоқли ҳудудлар, биохилмаҳиллик билан шўғилланувчи олимларга жуда фойдали бўлиши мумкин.

### Abstract

This research aims to analyze water surface dynamics of the Sudochi Lake in Aral Sea area which has an important role for livelihoods and ecosystem services. The surface area in the last few decades have changed differently which has a direct impact from availability of water resources from upstream zones of Amudarya river. The data for this purpose was obtained from remote sensing, particularly from Landsat data which provides freely available high resolution images of earth surface observation. The remote sensing images were prepared for 5 different years and from these images water surface was delineated by applying widely used supervised classification approach. The results of this study show how the Sudochi Lake surface have changed during different time periods and this study maybe a great use to decision makers or scientists who deal with wetlands and biodiversity.

### Аннотация

Эти исследования направлены на анализ динамики поверхностных вод озера Судочье в Приаралье, которая играет важную роль как средство существования и экосистемных услуг. Площадь поверхности озера в последние несколько десятилетия изменялся часто в зависимости от наличия водных ресурсов вверх по течению реки Амударьи. Данные для исследования были получены с помощью дистанционного зондирования, в частности, из данных Landsat. Изображения дистанционного зондирования были подготовлены в течение 5 лет и многие из этих изображений поверхности воды была очерчены с помощью широко используемого метода - контролируемой классификации. Результаты этих исследований показывают, как изменялась поверхность озера Судочье в разные периоды времени, и эти исследования могут быть полезными для принятия важных решений ученых, занимающихся исследованиями водно-болотных угодий и биоразнообразия.

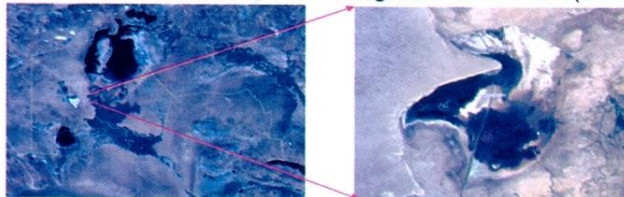
**Study area.** Study area of this research is located in lower end tale of Amudarya River in, Uzbekistan, Central Asia. It has two mainly one inflow rivers which is Amudarya. The Sudochi itself is wetland which has an inflow from above mentioned river. The water and mineralization balances of the Sudochi Lake consists inflow from the river, snow, rain and ground water. Thus, those inflows act as equalizer of the Sudochi with respect to its water surface, water quality and salt concentration. After water shrinkage as a result of evaporation without inflow and uncontrolled management, government of Uzbekistan conducted several projects for the purpose of rehabilitating the lake. Image below illustrates the location of Sudochi Lake

**Objective of the study.** The main objective of this study is to do sequential change analysis of the surface water change of Sudochi Lake. The analysis will be made on the basis of water surface area calculations for different years. Remote sensing data was available to carry out this study starting from 1970th until present time. This study will help for understating of historical changes of the Lake and importance of remote sensing information for such analysis for the future in different area.

**Methodology and data.** The Remote Sensing data was used in this study and obtained from United States Geological Survey (USGS) webpage. A good amount of data can be downloaded without any cost merely for the purpose of

research. The temporal resolution of Landsat data is 16 days and the spatial resolution is 30 meters. The data used in this study has an interval of between 10 to 11 years. Available data for most recent years was also downloaded to check the change in recent years and current condition of the study area. The swath of one Landsat image is about 185 km which cover one scene fully the entire Sudochi lake surface.

The principal objective of remote sensing is to capture the reflected and/or emitted electromagnetic radiations (EMR)



**Image1. Location of study area**

coming from different materials on the face of the earth. According to Howard, 1985, Remote Sensing is "concerned with the collection of data by a sensing device not in contact with the object being sensed, and the evaluation of the collected data, which is then termed information and is presented in map form or as statistics" (Meaden, J. Geoffery & Kapetsky, M. James). Satellite images are widely used in remote sensing.

**Methodology.** Methodology that is implemented in this work is described in steps. Major approach of this work was

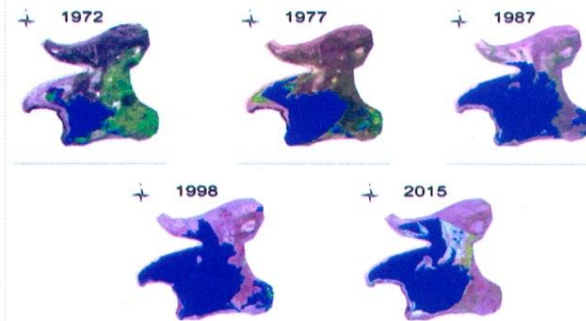
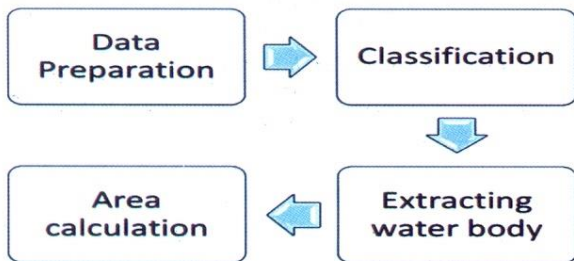
Available and used data for this study **Table 1.**

Serial No.	Number of scenes used	Year	Satellite
1	1	1972	Landsat 1
2	1	1977	Landsat 3
3	1	1987	Landsat 5
4	1	1998	Landsat 5
5	1	2015	Landsat 5

to apply supervised classification for extracting features from satellite images with satisfactory results. Methodology is a framework that allows humans knowledge to progress. Therefore methodology implemented in this research was divided into four main parts by analyst consisting of several sub parts. Following diagram shows these major portions as they feed one another.

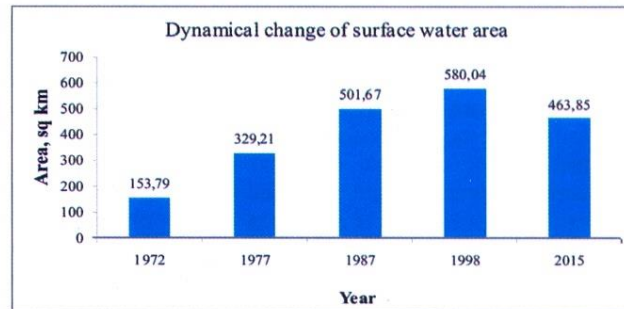
Data preparation was done for each Landsat data. Atmospheric correction was carried out to tune the image and prepare for further analysis. Supervised classification was used in this study and this method is fairly old but still yields very good results over large areas in short time. In this supervised classification approach image training was carried out and samples were collected. "Training is the process of defining the criteria by which these patterns are recognized"(Hord, 1982). Sample selection in supervised classification is done manually. This process will categorize the pixels into different land cover features that are visually recognizable. This recognition is done by observing to the image and having an extra knowledge about the land cover types in the study area. By this sample identification, software is given certain classes for which all pixels in the image should be classified. This way we have successfully classified water covered areas and extracted for area calculation.

**Results.** Classification was done for all images and these



**Image 2. Dynamical change of Sudochi Lake**

**Table 2. Illustrates the area calculated for each classified year**



classification results show how the changes took place over past periods and help to make some analysis and provide information for stakeholders. Image below illustrate the area-calculated result for different years.

These numbers show that there is huge water surface area change between 1972 and 2015. As it is visible from the chart, the water surface of Sudochi Lake in 1972 was about 153 square km and increased by time after conducting some activities and projects to save the lake. Today in this lake about 463 square km area of water exists.

**Conclusion.** The aim of this study was to delineate water surface of Sudochi Lake for different time spans using publicly available Landsat Data. The results gave clear water surface values for different years. Through this study it was possible to demonstrate that one can clearly demonstrate water dynamics in seas or lakes. Using automatic classification tools, it was possible to delineate water surface for different years clearly. The results of such study can be well used to better understand the behavior of the Lake and ecosystems services in the region.

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