The rehabilitation assessment is one of the most effective and advanced ways of improving environmental management

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Abstract

"The National Geo-information Centre for Natural Resource Management" (NGIC) project funded by Dutch Government was implemented by the Ministry of Nature, Environment and Tourism. One of the goals was to contribute to improving rehabilitated condition within this purpose to develop a rehabilitation assessment approach for the mining sector within Mongolia with the application of GIS/RS techniques and Spatial Multi Criteria Analysis (SMCA).

Numerous different satellite images with different resolutions have been reviewed for this and it was concluded that Quick bird and Ikonos are best suited to review and monitor environmental aspects.

A case study has been conducted in which SMCA was used to analyse the best options for a mining project taking into account i) waste disposal site selection, ii) best available mining technology and iii) suitable habitat for small mammals.

In addition the sketch-maps of each component (rivers, forests, cliffs, mountain slopes, hills, mining village location, fresh and waste water reservoirs, external and internal piling sites, mining site road networks etc.) were first developed in GIS.

With respect to this the soil and vegetation map was made based on the field survey and confirmed with high-resolution satellite image and shown with illustrative form using controlled classification method per each case.

Both these methods, the development of all maps in GIS and the use of SMCA is strongly advised to become the standard for rehabilitation assessment work in mining site of Mongolia.

Introduction

Bevause restoration of nature and combating aridification and desertification is complicated issue related with climatic changes; it can not be solved fully by the present study. Within the framework of project, mining company was choosen and GIS/RSS techniques were used to impacts on nature and environment and its restorations.

All image data revealing nature and environmental conditions are easy to realize and helpful to make correct decisions.

Study materials

In the present study "Odod Gold" and "Khan-Shijir" companies, which run activities in the middle area of Ulziit River in Bumbugur soum of Bayankhongor aimag were selected [1].

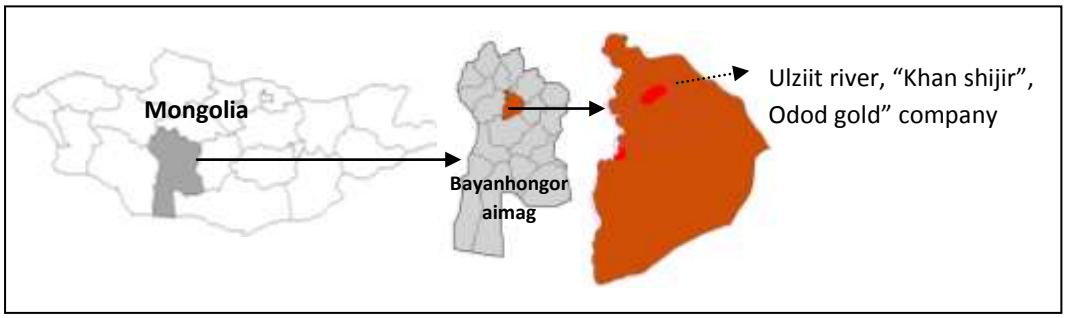


Figure 1. Localizations of gold mining areas of "Odod Gold" and "Khan-Shijir" companies

Climate. Climate in Baidrag basin areas is characterized with severe continental conditions, including relatively higher lands, earlier cooling, less snowfall in winter, periodical sudden colds in cold winter, shorter summer, warmer daytime, cooler night time, windy during day, less windy in night, and lack of humidty.

Annual average air temperature in January ranges from -20^0C to -25^0C, in July from 20^0C to 23^0C, and absolute minimal temperature is -39-43^0C in January and absolute maximal temperature is $+30^0$C to $+34^0$C.

Sum of annual precipitation in this area is 145-160 mm and 90-95% of annual precipitation fall durin warm seasons.

Average wind speed is 3-9 m/s, sometimes reaches 12-16 m/s. Wind strength increases since march, 60% of April to June months are windy and therefore lack of humidity is greater in this period [1].

Soil cover. In this region soil of valleys between mountains and steppe is dominant. Valley of Ulziit river is bordered with low hills and mountains and these mountains compose of volcanic slate, clay slate and lime stones [1].

Vegetation. Bumbugur soum has arid and severe climate and vegetation is sparse, dominated with bushes and semi-shrubs, and its territory belongs to stony desert type. From the study, it is shown that Salsola spp, Caragana spp, Artemisia spp, needlegrass, etc are major plants forming communities.

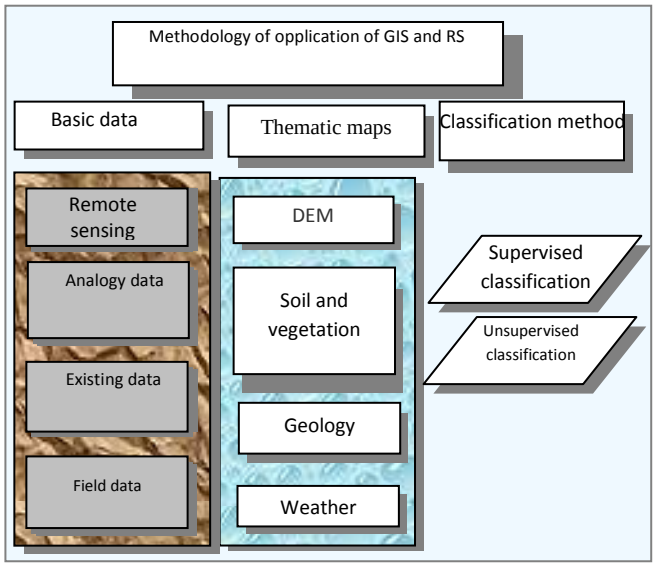
Wild animals. Small mammals, including *ochotana sp.*, and *meroinus sp*, *upupa epops*, and such birds as *aegypius monachus, falco sp., milvus migrans, phalacrocorax carbo, aquila chrysaetos, antropoides virgo, charadrius veredus,* and Eremophila alpestris are abundantly distributed.

Data and materials used

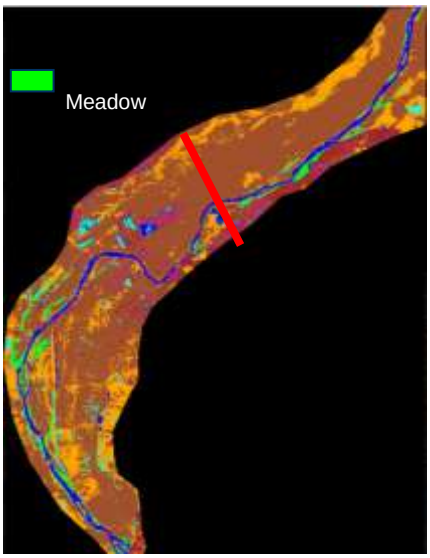
Data of 3 main types were used in the study. They are as follows:

1.Also data for surveillance of 3 types were also used.

- LANDSAT- TM with 30 m capability of 7 channels 28 June, 2000
- ASTER data with 15 capabilities of 14 channels of 23 April, 2004
- SPOT data with 5 m preciseness of 4 channels 17 September, 2007



2. Topgraphical images: L-47-67, 68, 55, and 56



3. Data collcected by field trials

Except of above data and materials data of GIS sofwares such as ARCGIS 9.2, ENVI 4.0, ArcView 3.2, ERDAS and IMAGINE 9.0 were used.

Methods of the study

For evaluation of adverse consequences of mining industry on nature and environment within the project framework, RSS and GIS technologies, and multi-criteria analysis were used and such evaluation will be modern technological solution, which determine easily and precisely all isssues for combating aridification and desertification at both regional and local levels.

Results

We are presenting outcomes of our study on the feasibility of restoring nature and environment of local areas by using GIS/RSS in order to make restorations and determine its progress and planning for combating aridification and desertification caused by mining industry impacts.

Determination of migratory bird habitat

It is probable that after restoration of the areas, which were abandoned during mining activities, water birds and small mammals are able to acclimatize again in their previous habitat.

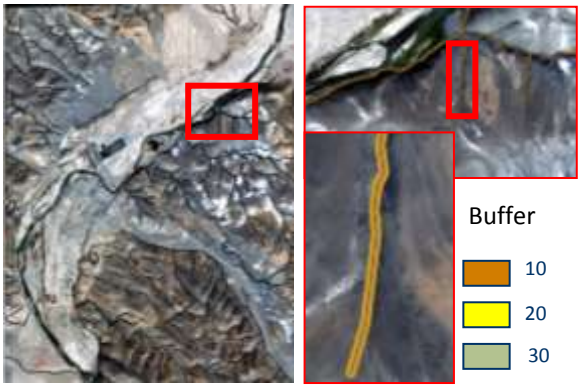


Figure 4. Image of potential habitat of small mammals

Because small mammals are mostly living in ravines and shallow gullies, images of sloppy sides were taken, buffers were drawn by estimating to be 10 m, 20 m and 30 m using GIS. In other words, it means images of areas where small mammals are bale to live at distance of 10-30 m from ravines.

Determination of dustiness caused by mining

Figure 5. Air pollution
Dusts resulted from loose soil

It is probable that dustiness is the highest in the area of real mining activities. Large amount of dusts appear in the air due to such factors as greater sandy and loose soils and poor vegetation, which are clear from localization far from river valleys and structure of soil.

Determiantion of soil type changes

Soil type changes can be determined by analyzing data at various temporal periods of satellite imaging.

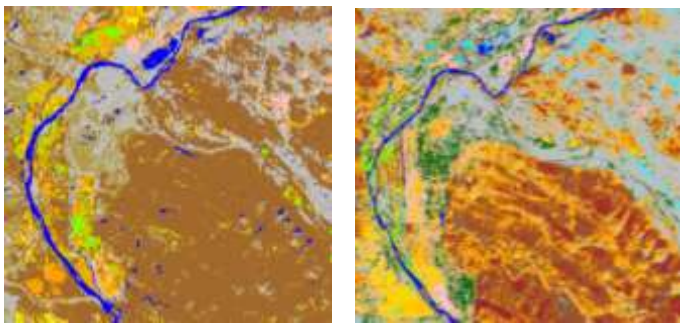


Figure 7. Soil map processed from satellite images of 2007 and 2008

From above images, the soil type changes of mining areas in association with the company's restoration activities year by year can be easily visualized and concluded.

Description of favorable conditions of mammals

Four main factors (aspect or solar reflection, sloppiness of the area, vegetation and altitude) exerting effects on habitats of small mammals can be determined as follows [4,5]:

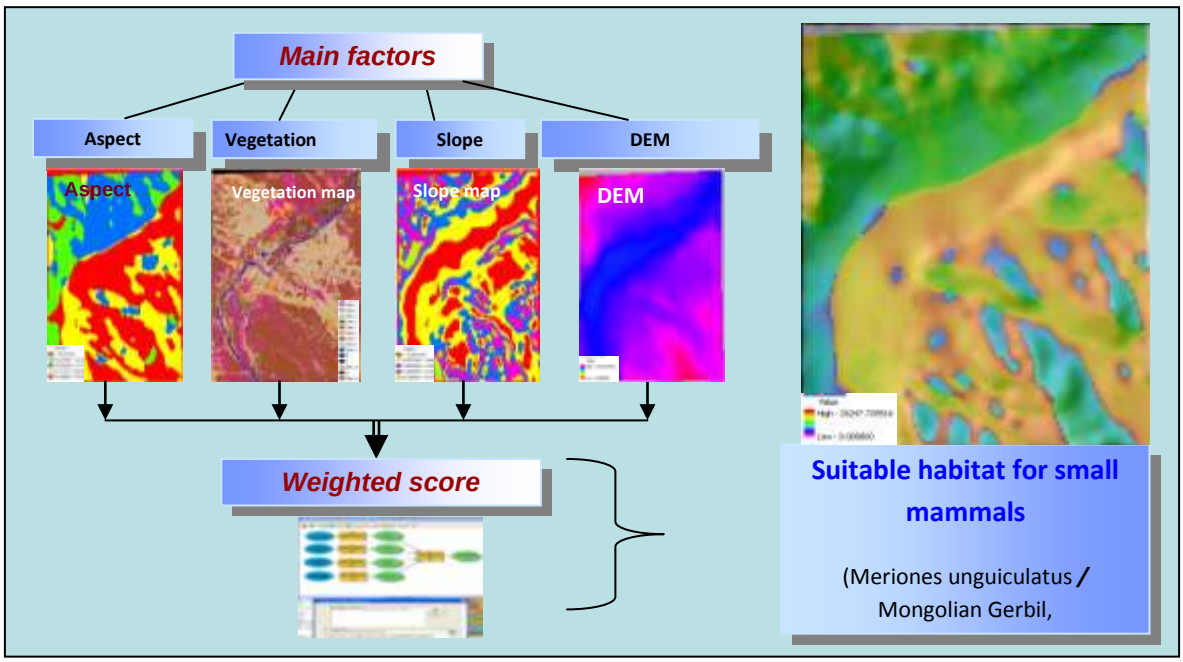


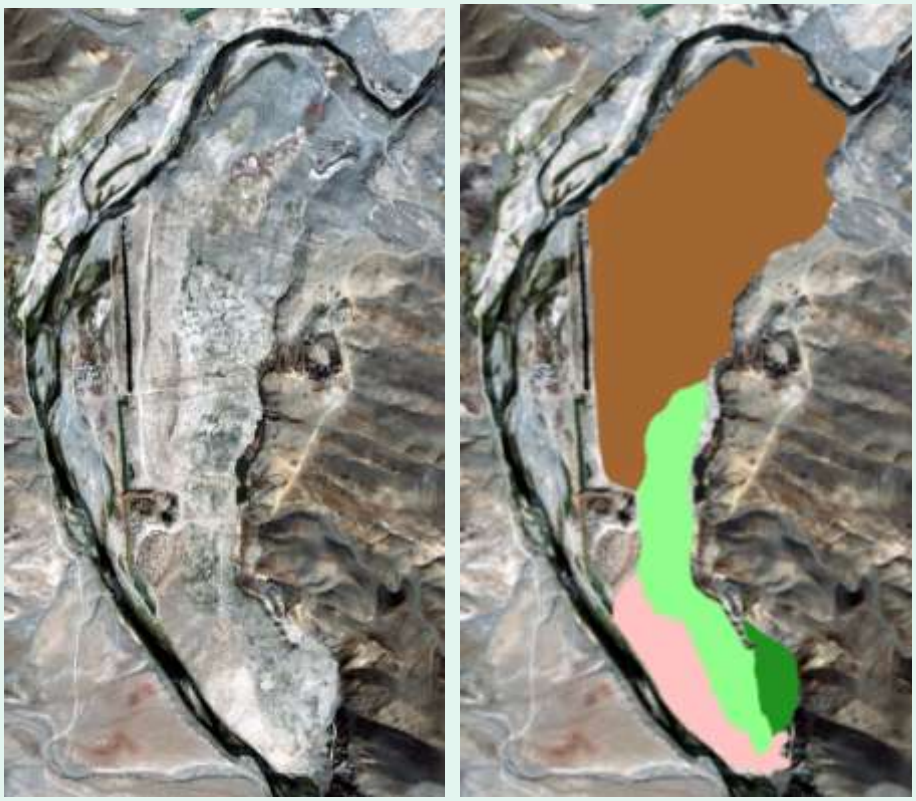
Figure 8. Map of the area suitable for habitat of mammals

Small mammals in the area are living in higher, rocky, and sloppy places of mountain. Although mining areas are habitat of these animals, they left the area because of 24 hour continuous noises of the mining activities. However, it is highly probable that these animals will return back these areas after closing the mines. It has been observed animals returned back in some areas.

Progresses and planning of restoration activities

Use of GIS/RSS in restoration activities after completion of mining is enormously important for improvement of system of control on restoration [2,3]. Images above 5 m are not suitable for restoration and its control, if satellite images of good quality are not used because area of mining use occupies smaller part. In the project framework, QUICK BIRD satellite image with 60 cm preciseness was used. All data, including restoration levels, presence of technical

and biological restorations, planting of trees, and areas of planting can be described and concluded from satellite images.



Picture 9. Identification of rehabilitation process using satellite image

For determination of impacts, some examples of application of significantly novel method were shown. This method is called multi-criteria analytic method and was used for determination of habitat of small mammals. Mammals of only 2 genera were observed in the area selected by us and we determined initially 4 influential factors for making images of habitats for these animals. They include map of vegetation, aspect or solar frontal and northern state, sloppiness and altitude. It is fully possible to describe solutions of any issues by using method made this image.

The following conclusions can be made by associating results of this work with climatic changes:

- Decreased precipitation occurred, number of windy days, and increased frequency of sudden heating from May through October each year during peak period of mining activities exert adverse impacts on restoration of degraded lands. Therefore, it is important to organize properly restoration activities in association with climatic changes.

- Determination and expression of potential impacts, their quantities and limits, and minimizing their impacts will be more suitable for the reality and they influence greatly on determination of factors leading to climatic changes.
- Because restoration of lands degraded by mining activities and combating aridification and desertification of local areas, accomplished within the framework of this project are capable of giving tangible outcomes in improving climatic changes, it is suggested that the methodology is fully practicable in the reality.

Abbreviations:

GIS – Geographical and information system

RSS – Remote sensing surveillance

MCA – multi-criteria analysis

References

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