USING SATELLITE IMAGERIES FOR THE SURVEY OF AQUATIC VEGETATION AND OTHER RESOURCES

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ABSTRACT

Conventional ground surveys have been used for the survey of aquatic resources for a long time. However, modern scientific techniques like the use of remote sensing have revealed that ground survey alone is inadequate and in most cases not realistic enough to obtain results from spatial resources that are widely distributed. Unlike conventional ground survey studies, remote sensing techniques offer the possibility for aquatic and non-aquatic spatial resources to be captured through satellite imageries as they are truly distributed over space. Results from the analyses of SPOT imageries of Kainji Lake using ArcView Geographical Exploration System techniques show the distribution of vegetation cover around the lake, bathymetry, distribution of fishing villages, wetlands and other important aquatic features.

INTRODUCTION

According to Howard (1985), Remote Sensing is a term used to describe the collection of data from objects by sensing devices not in contact with such objects. The technology has grown gradually over time to the present sophisticated state. According to Meaden and Kapetsky (1991), the first camera was made in France in the 1830s but it was not until 1858 that the first aerial photograph was taken from a capture balloon near Paris. The first aerial photograph from an aeroplane was taken in 1909 over Centocelli in Italy, while photo interpretation became a recognised field of expertise during the First World War. Only later in the 1920s and 1930s did civilian use of the aerial photography start, while during the World War II the study of bathymetric data, development of colour infra-red film, advances in radar technology etc began. The post 1950s saw the launching of orbital satellites after the successful launching of SPUTNIK 1 in 1957. This marked the beginning of exploration of the earth's resources from space, since then many satellites have been launched into space. Meaden and Kapetsky (1991) reports that the main satellite systems are: Landsat 4 to 5 launched in July 1982 and March, 1984,

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Spot 1, (systeme pour L'Observation de la Terre) launched in February, 1986. The third, ERS-1 owned by European Space Agency was launched in 1991, MOS-1 (Marine Observation satellite lunched in February, 1987) and KOSMOS (launched by the then Soviet Union).

The National Institute for Freshwater Fisheries Research under the Aquatic Vegetation Programme in collaboration with the Kainji Lake Fisheries Promotion Project bought two scenes of SPOT image of the Kainji Lake and its environs. The snap shots were taken by the orbiting satellite on the 6th April, 1993 at 10hrs 19mins 11secs exactly. The scenes were obtained primarily to ascertain the status of the aquatic vegetation of the Lake. This report discusses the results from computer analyses of these scenes to show the capabilities of using remotely sensed imageries as tools for aquatic vegetation and other spatial resources survey and studies.

MATERIALS AND METHOD

SPOT Satellite Imagery of Kainji Lake

The scene parameters of the SPOT Image obtained gave the scene ID as 267-330 93/04/06 10:19:111X. The instrument for the scenes was HRVI on a processing level of IB, spectral mode of XS with 3 Spectral bands and Spectral indicators of XS1, XS2 and XS3. The orientation angle for the scenes was 008.8 degrees, the incidence angle given as R2.3 degrees and the sun angles was +098.9 azimuth with 068.4 elevation. The gain numbers of the scenes were 6,7, and 5 but the absolute calibration gains numbers were 0.96426, 1.07394 and 1.20878.

The scenes have 3003 numbers of lines and 3188 numbers of pixels per line while the raw first image pixel within the record was byte number 33.

ArcView® Geographic Exploration System

The SPOT Scenes that came in a single compact disc was loaded into an ArcView® Geographic Exploration System (a geographical information system software installed in one of the NIFFR computers for viewing and analyses). The system, which is designed by the Environment Systems Research Institute (USA), displayed the scenes of the SPOT Image on the VDU. The software also saved as tool for examining the images in greater details offering possibilities for spatial and logical quarries to be performed. With this set up the entire lake area was navigated intensively on the screen.

Collection of "Ground Truth" Data

Opportunity was given through the Aquatic Programme under the Ecological Fund, for the confirmation and measurement of objects on the scenes through bi-annual surveys of the Lake. Between 1994 and 1999 over ten ground surveys were undertaken covering the entire lake area. Many aquatic plants were collected as samples. Sections of the lake showing cover of blue green algae, Niger

grass, shallow sub-terrain Islands, creeks, islands and other landforms related to aquatic life, were visited and samples were obtained where needed.

RESULTS AND DISCUSSION

Plate 1 shows a printout of SPOT Images (merged) of Kainji Lake basin covering latitude N0 10°19'10" Longitude EO04° 13'41" as the first corner. Latitude N0 10°14'13", Longitude E004°45'57" as second corner. Latitude N009°47'19" E004°06' 28" as third corner and Latitude N009°42'22", Longitude E004°38' 42" as fourth corner in line with specifications given by SPOT IMAGE of France.

The plate clearly shows spectral data as analysed with the ArcView software. From the North Eastern part of the photograph the bright white dots connotes settlements (Yauri and others). The Grey colour show bare ground devoid of any vegetation. At the time this image was taken, grasses are just about or beginning to sprout. However, if the photograph was taken later in the year around the peak of rainy season, the Grey areas will be shown as green. The very dark Grey sections scattered around the lake basin are wetlands. These can be seen all around the photograph especially in the North Eastern part around the lake and along creeks and rivers entering the lake. Although the rivers and creeks are dried at this time the Image is able to show that the soil around these areas are wet. An exception to this colour band is the object at the middle of the lake. This is not possibly an island but a sub-terrain island (a once existing island before the creation of the lake). Downwards, below this portion of the picture, South Eastward are also bits of submerged islands.

Foge Island is clearly shown covered with vegetation (indicated in red colour), at the time only by Niger grasses. The grey patches to the east of the island are bare rocks, which are hanging cliffs as seen on ground surveys. The black dots on this island and around other parts of the lake have been confirmed as mineral deposits during ground survey. These minerals are soft shinning particled-rocks occurring at the shore of the Lake.

Below Foge Island is old Bussa Island. Garafini Island is seen as a very small dot below. The blue colour band represent water, while the very dark blue dots were confirmed as blue green algae scattered all along the western part of the lake from Kokoli down to Malale.

The Western part of the lake shows a high density of vegetal cover compared to Eastern part. The thick vegetal covers on the west particularly to the south are parts of Kainji Lake National Park forest reserves. The density increases southwards into the Park proper.

The dam site is clearly shown at the Southern tip of the lake with the Jebba Lake

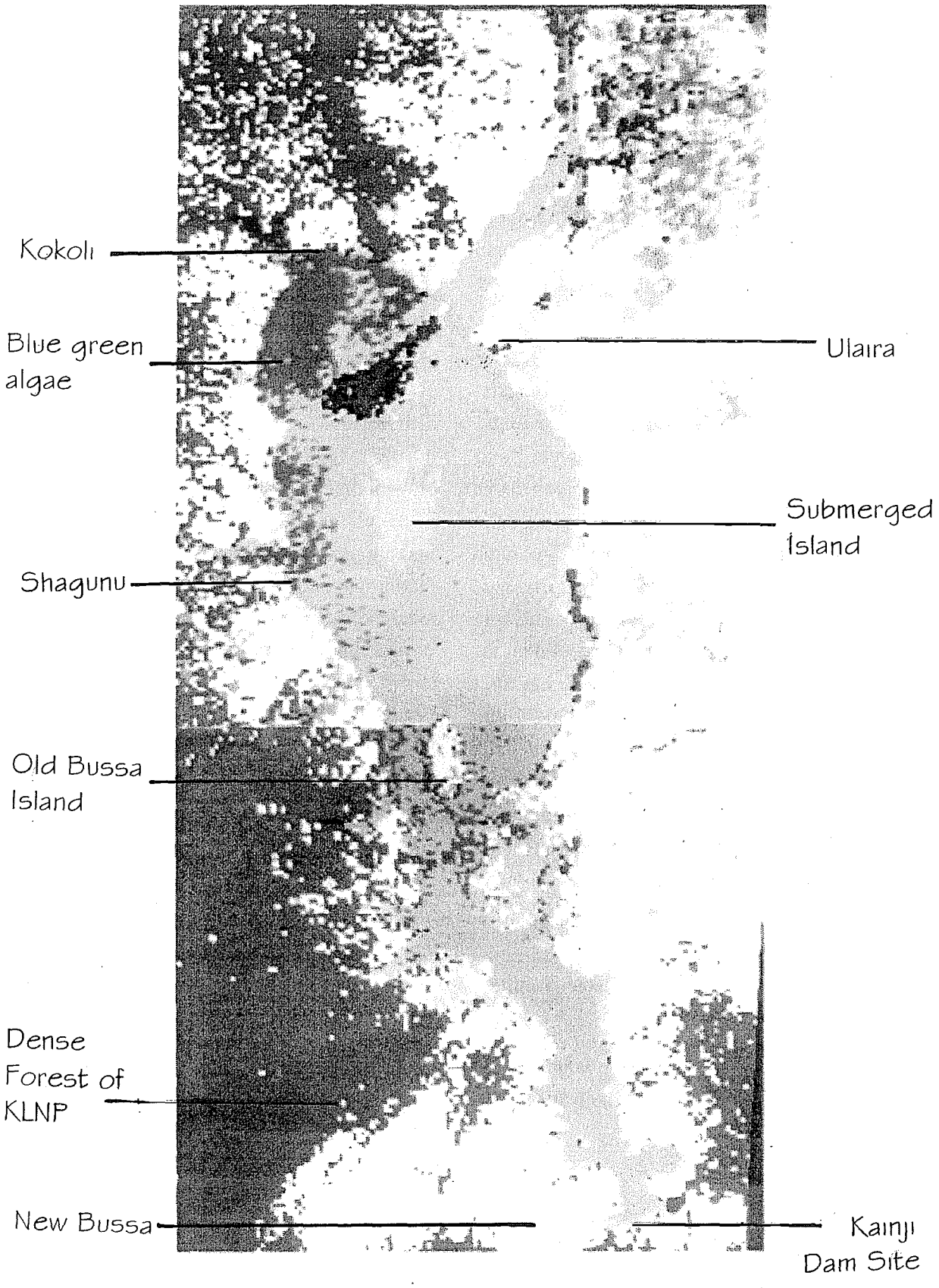

FIGURE1: SPOT Image of Kainji Lake

trailing further southwards. The bright white sections westward of the dam axis is New Bussa.

The yellow dots on the North Western part of the Image are not yet confirmed. The lake was significantly free of water hyacinth at the time this image was taken. A few may be present under other aquatic plants around the islands and shorelines but the scenes show no significant floating weeds.

Satellite imageries offer opportunity for the user such as, scientists, governmental agencies, developmental projects etc to make quick and comprehensive conclusions of areas under study. For example it is expected that the areas with blue green algae may have abundant occurrence of *Synodontis spp.* that feed on the algae intensively. The area can also serve as breeding grounds for them and can be marked as a safe haven at particular times. The occurrence of the algae particularly at Kokoli bay may indicate high concentration of fertilizers being washed in from farms around the area.

The distribution of wetlands show drainage pattern of the lake and gives an insight into possible locations for siting fish ponds using ground water resources as a factor.

The forest pattern of the lake basin as shown on the images gives a clear picture of acute deforestation on the eastern side compared to the western part. It also shows gradual deforestation on the northwestern part. Since this picture was taken in 1993, a more recent one taken in 1999 for example will give a clear picture of the status of the forest reserve.

CONCLUSION

The use of satellite imageries for spatial resources research is very important at the present times. The technology offers far reaching perspective of the resources and their pattern of distribution, thereby giving the user, be it in the field of scientific enquiries, developmental projects or documentation of the natural resources the opportunity of making good decisions. The benefits are numerous and the information obtained are more precise compared to those obtained by ground survey.

REFERENCE:.

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