A PROCEDURE FOR MONITORING THE SPREAD OF WATER HYACINTH USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS (GIS) - A CASE STUDY OF LAKE KARIBA

BY

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DECLARATION

I, **CHRISPIN NAMAKANDO**, do hereby declare that this dissertation is entirely the outcome of my own work and that to the best of my knowledge, it has never been presented in part or wholly at this or any other University for the award of the degree.

All figures on tables are original except for those whose sources have been acknowledged or referenced, as defined in the University's policy on plagiarism.

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Abstract

Water hyacinth is, after eutrophication, the largest threat to waterways, lakes and dams throughout Africa. The aim of this study was to develop a procedure for m the spread of water hyacinth on Lake Kariba using Remote Sensing and Geographic information System. The spread of water hyacinth on Lake Kariba is influenced by nutrients (phosphates and nitrates), climate, wind and wave action and lake level variation. On the Lake the weed is found as fringe on shore line, free floating and thick mats. A procedure for monitoring the spread of water hyacinth on Lake Kariba was developed considering its occurrence, the use of Global Positioning System and satellite imagery. The spread of water hyacinth on Lake Kaiba was studied using satellite imagery and through boat surveys. Remote sensing software Idrisi 2.0 was used to process and classify the satellite image whereas ArcView GIS 3.2a was used for analysis. Idrisi 2.0 and ArcView GIS 3.2a software were used to test specif steps of the procedure. The hybrid classification procedure (Using the ISOCLUS module of Idrisi) was found to be better suited for monitoring the spread of water hyacinth than the supervised and unsupervised methods of image classification. Seven (Two Spot and Five Landsat) satellite images were used to assess the spread of water hyacinth in this study. The extent of water hyacinth on Lake Kariba was estimated at 572 ha in 1995 (Spot), 1422 ha in 1999 (Spot), 455ha in 2001 (Landsat) and not detected by Landsat satellite images captured in 2004 and 2005. The weed spread was lly estimated to be 50 ha in January 2004, 10ha in December 2005 and 20ha in July 2007 through boat surveys. Overall, water hyacinth spread from 682ha in 1992 to 4510ha in 1998 after which it reduced to very low levels not warranting the use of satellite imagery in 2007.

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List of Abbreviations and Acronyms

ASAR	Advanced Synthetic Aperture Radar
BRLi	BRL Ingienierie
BSQ	Band Sequential
B&W	Black and White
CNES	Centre National d'Etudes Spatiales
CPF	Calibration Parameter File
DEMs	Digital Elevation Models
DIMAP	Digital Image Map
DNPWM	Department of National Parks and Wildlife Management
ESRI	Environmental Systems Research Institute Inc.
ETM+	Enhanced Thematic Mapper Plus
FEMA	Flood Insurance Rate Maps
FIRMs	Federal Emergency Management Agency
FSL	Full supply level
FSTL7	FastL7A format
FTP	File Transfer Protocol
GCC	Grasslands Conservation Council of British Columbia
GCPs	Ground Control Points
GIS	Geographic Information Systems
GLCCD	Global Land Cover Characteristics Database
GPS	Global Positioning System
GWP	Global Water Partnership

HDF	Hierarchical Data Format
HTML	Hypertext Markup Language
IAS	Image Assessment System
ICPR	International Committee for Protection of the Rhine
IWRM	Integrated Water Resources Management
Interpol	International Police
IRD	Institut de recherché pour le developpment
KIA	Kappa Index of Agreement
KNBC	Kariba North Bank
L0Rp	Level 0 Reformatted
L1G	Level 1 Geometrically Corrected
L1R	Level 1 Radiometrically Corrected
MOL	Minimum Operation Level
MRL	Maximum Retention Level
MSS	Multispectral Scanner
NACA	National Advisory Committee on Aeronautics
NASA	National Aeronautics and Space Administration
NCSA	National Center for Supercomputing Applications
NFIP	National Flood Insurance Program
NIR	Near Infra Red
NOAA	National Oceanic and Atmospheric Administration
Radarsat	Radar Satellite
SADC	Southern African Development Cooperation
SAR	Synthetic Aperture Radar
SLC-off	Scan Line Corrector Off
SWIR	Shortwave Infrared
TIROS	Television Infrared Observation Satellite
TM	Thematic Mapper
ULKRS	University Lake Kariba Research Station
UML	Unified Modelling Language
UNZA	University of Zambia

USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WGS	World Global Sphere
XML	Extensible Markup Language
ZRA	Zambezi River Authority