SPATIAL COVERAGE OF WATER HYACINTH INFESTATION AROUND LAKE TANA, ETHIOPIA

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ABSTRACT

Water hyacinth, Eichhornia Crassipes, is an aquatic invasive species which is native to South America. It profoundly affects the tropical and subtropical region of the world. In addition, it is recognized as one of the worst weeds and most aggressive invasive species by the International Union for theConservation of Nature (IUCN). In Africa, Zimbabwe is one of the first African countries which water hyacinth was officially recorded. In Ethiopia, it announced in 1956 in Koka Lake and Awash river. Water hyacinth infestation around the Lake Tana is aggravated from time to time. This study was conducted on five woredas (such as Dera, Fogera, Libokemkem, Gondar Zuria and Dembia) which have a higher infestation of water hyacinth coverage. There were about 5394 hectares of water hyacinth areal coverage of the whole woredas at the cost of the Lake. From those woredas, Dembia was holding most areal coverage (2563 hectares) of water hyacinth infestation. To determine the areal extent of water hyacinth around the lake, consecutive ground control truck points was calibrated.

INTRODUCTION

Water hyacinth, *Eichhorniacrassipes*, is a perennial, herbaceous, aquatic plant and is *Native to* the Amazon Basin in South America. Water hyacinth has emerged as a major weed in more than 50 countries in the tropical and subtropical regions of the world with profuse and permanent impacts (Patel, 2012; Téllez et al., 2008; Samuel and Netsanet, 2014).Originally from the Amazon Basin, its entry into Africa, Asia, Australia, and North America was facilitated by human activities (Dagno et al., 2012). Water hyacinth has been identified by the International Union for Conservation of Nature (IUCN) as one of the 100 most aggressive invasive species (Téllez et al., 2008) and recognized as one of the top 10 worst weeds in the world (Gichuki et al., 2012; Patel, 2012). It is characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance (Zhang et al., 2010).

In Africa, where water hyacinth is listed by law as a noxious weed in several countries, it is the most widespread and damaging aquatic plant species. The first African countrywhich water hyacinth weed was officially recorded in Zimbabwe in 1937. In Ethiopia, water hyacinth was announced in 1956 in Koka Lake and Awash River (Samuel and Netsanet, 2014; UNEP, 2013). It also prevailed in most of rift valley lakes, canals, reservoirs and irrigation water supply within different manifestation magnitude (Firehun et al, 2014). Lake Tana is the one in which water hyacinth infestation highly occurred.

The economic impacts of the weed in seven African countries have been estimated at between US$20-50 million every year. Across Africa, costs may be as much as US$100 million annually (UNEP, 2006). The success of this invasive alien species is largely due to its reproductive output. Water hyacinth can flower throughout the year and releases more than 3000 seeds per year. The seeds are long-lived, up to 20 years (UNEP, 2013).

Water hyacinth has anegative ecological impact on freshwater bodies, suppressing all other species growing in the vicinity. Large water hyacinth mats negatively affecting microbes, prevents the growth and abundance of phytoplankton, prevent the transfer of oxygen from theair to water bodies (Gichuki et al., 2012, UNEP, 2013). When the plant dies and sinks to the bottom

the decomposing biomass depletes oxygen content in thewater body. Death and decay of water hyacinth vegetation in large masses deteriorate water quality and the quantity of potable water and increases treatment costs for drinking water (Patel, 2012, Mironga et al., 2011, Ndimele et al., 2011).

GIS and remote sensing have played an immense role to map the distribution and areal extent of invasive species. As a result, it uses as a decision support system toolfor decision makers. Integrated GIS and remote sensing have been applied to map the distribution of several plant and animal species, their ecosystems, landscapes, bio-climatic conditions and factors facilitating invasion (Los et al., 2002).The study has used both GIS and Remote sensing integrity to demonstrate the spatial extent of water hyacinth infestation on the Lake Tana. Therefore, this is significant for researchers, environmentalists, botanists, and decision supporters as a baseline information to perform further analysis and decision making.

MATERIALS AND METHODOLOGIES

Data sources

The main sources of data for this paper were Google earth image, ground control GPS points, and Sentinel 1 high-resolutionLandsat image has used for analysis.

Methodologies

Lake Tana is found in $10^0$58'-$12^0$47' N latitude and $36^0$45'-$38^0$14' E longitude. The water hyacinth is highly infested at the coast of Dera, Fogera, Libokemkem, Gondar Zuria and Gorgora woredas. GPS points were calibrated from at the coast of the lake where the weed is found and the water hyacinth infestation inside the lake using local boats. The coordinate points were put in ArcMap and convert them into shapefiles. Those shapefiles were open in Google Earth and digitize by following the path of GPS truck points to calculate the area of water hyacinth infestation coverage for each woreda.Besides, United State Geological Survey (USGS) earth explorer imagery sentinel 1data was used as an input to nominate the area coverage by overlaying vector polygon with image data.

Result and Discussion

The arealextent and magnitude of water hyacinth in each district (Woredas) is different according to the result (Table 1).

Woredas Name	Area Coverage in Hectare
Dera	260
Fogera	755
Libokemkem	1038
Gondar Zuria	780
Dembia	2563

Table 1: Area coverage of each woreda.

Water hyacinth in Dembiaworeda is higher than the remaining woredas as shown in the table above. Around the coast of this woreda, agricultural activities highly occur and the water hyacinth is highly affecting the growth and product of farmers' crops. Most of the time, water hyacinth growth depends on the landscape situation of the area. Under the shelter of huge trees and areas

which have shallow depth on the coast of the lake, the growth and greenness of this invasive species are higher than those areas which have deep in depth. Coastal areas which are rocky in nature, around the lake, has aminimum coverage of water hyacinth is available. For instance, Deraworeda around the Tana Kirkos monastery, some parts of this monastery is covered by rocks. And the remaining part of the monastery is covered by huge trees which have large canopy cover. Water hyacinth area coverage and its extent around those two different land cover parts of themonastery are significantly higher around the coast of large canopy tree coverage than the rocky one.

There were about 5396 hectares of water hyacinth coverage has found in all woredas. Dembia woreda has covered 2563 hectares of water hyacinth and adversely affected by this invasive species than other woredas. Whereas, Dera woreda has the least areal extent coverage of water hyacinth than other woredas. The thinner parts of the following map (Figure 1) demonstrated that the areal extent of water hyacinth in that woreda/place is minimum coverage of water hyacinth infestation than the remainingandvice versa.The violet color which is overlayedon the Sentinel 1 Landsat image (Figure 2) depicts that, the water hyacinth infestation of an areal extent from coast to inside part of the lake.

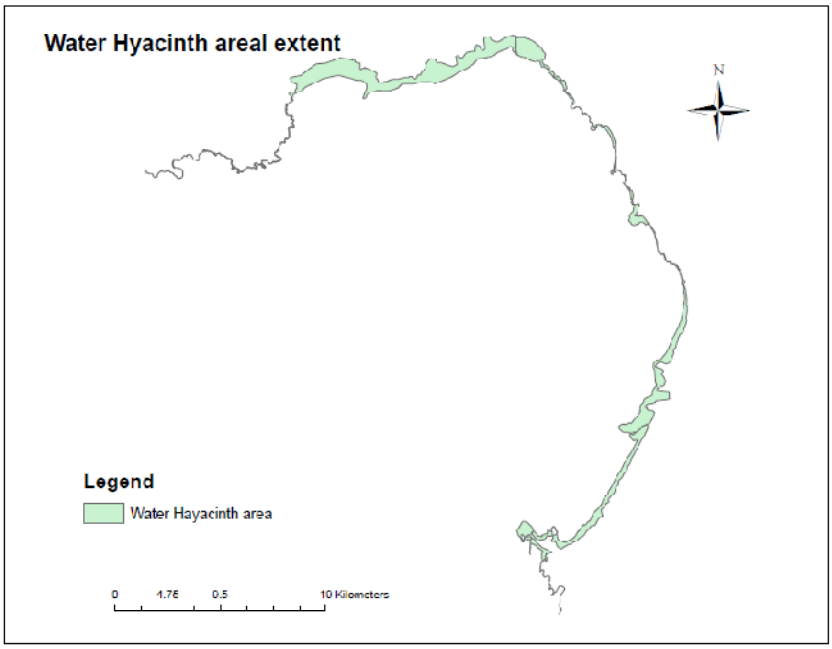

Figure 1. The total areal extent of water hyacinth around Lake Tana.

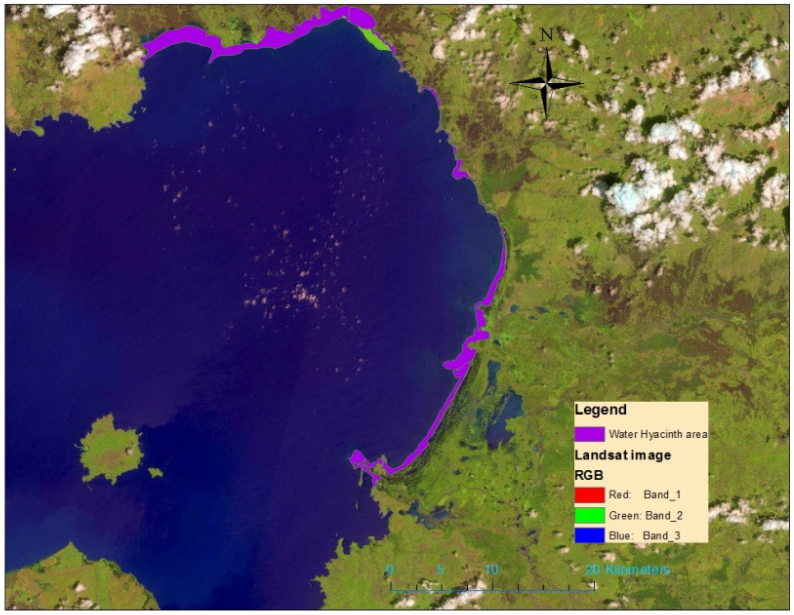

Figure 2. Overlaid Sentinel 1 Landsat image with shape file of water hyacinth infestation.

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