|| Volume 5 || Issue 12 || May 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH & ENGINEERING TRENDS
Multidisciplinary Journal
Double-Blind Peer Reviewed Refereed Open Access International Journal

QUANTIFICATION OF WATER HYACINTH IN P.C.M.C. AREA BY GIS AND ASSESSMENT OF METHODS OF MANAGEMENT.

Prof. Rahul Udata, Prajakta Shinde, Shubham Shewale, Shradha Yelavi, and Vikas Tripathi
Dhole Patil, Survey No 1284, Near EON IT Park, College Road, Vitthal Nagar, Kharadi, Pune, Maharashtra 412207

Abstract—Water hyacinth is a free-floating perennial aquatic plant (or hydrophyte) native to tropical and sub-tropical South America. Water hyacinth was introduced as an ornamental crop in many countries more than a century ago. However, its beauty is only surface deep and developed into invasive species due to their adaptability for a wide range of fresh water ecosystems and their interference with human activities. Hence it is necessary to remove water hyacinth. Government issues the tender of it every year so the estimation has to be quick and appropriate. This project suggest the method to estimate water hyacinth removal cost quickly and appropriately by considering water hyacinth distribution in water bodies. It also suggests the comprehensive strategies to manage this removed water hyacinth. This plant is suspended on water surface as the carbon to nitrogen ration of the plant is high it can be used as biomass. It give information about use of water hyacinth in different industries like briquette, paper, fertilizer, etc.

----------∴ ∴ ∴----------

I INTRODUCTION

A. Introduction

Water hyacinth is a free-floating perennial aquatic plant (or hydrophyte) native to tropical and sub-tropical South America. With broad, thick, glossy, ovate leaves, water hyacinth may rise above the surface of the water as much as 1 meter (3 feet) in height. The leaves are 10–20 cm (4–8 inches) across on a stem which is floating by means of buoyant bulb-like nodules at its base above the water surface. They have long, spongy and bulbous stalks. The feathery, freely hanging roots are purple-black. An erect stalk supports a single spike of 8–15 conspicuously attractive flowers, mostly lavender to pink in color with six petals.

Water hyacinth was introduced as an ornamental crop in many countries more than a century ago, due to its attractive appearance and aesthetical value in the environment. However, its beauty is only surface deep and developed into invasive species due to their adaptability for a wide range of fresh water ecosystems and their interference with human activities. So it has a bad reputation of being **one of the worst aquatic weeds** in the world. Known as the "German weed" in Bangladesh, the "Florida Devil" in South Africa, the **"Terror of Bengal"** in India and the "Japanese Trouble" in Sri Lanka, the plant grows extremely fast.

B. Invasive growth of water hyacinth

Within a period of eight months, ten water hyacinth plants can reproduce 655,360 plants that can cover approximately half a hectare of the surface area. That nutrient concentration and increased Land Surface Temperatures (LST) are two of the most important aspects, influencing the growth and re- production of water hyacinth species in open water bodies. So far, water hyacinth has spread to most of the tropical fresh- water bodies throughout the world, and has been described as one of the most invasive weed on the planet.

The socio-economic effects of water hyacinth are dependent on the extent of the invasion, the uses of the impacted waterbody, control methods and the response to control efforts. Ecosystem-level research programmes that simultaneously monitor the effects of water hyacinth on multiple trophic-levels are needed to further our understanding of invasive species.

The effects of water hyacinth on ecological communi- ties appear to be largely nonlinear. Abundance and diver- sity of aquatic invertebrates generally increase in response to increased habitat heterogeneity and structural complexity provided by water hyacinth but decrease due to decreased phytoplankton (food) availability.

C. Softwares

1) Google Earth: Google Earth is a computer program, formerly known as Keyhole EarthViewer, that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite im- ages, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles.

2) Coordinates, or by using a keyboard or mouse. The program can also be downloaded on a smartphone or tablet, using a touch screen or stylus to navigate. Users may use the program to add their own data using Keyhole Markup Language and upload them through various sources, such as forums or blogs. Google Earth is able to show various kinds of images overlaid on the surface of the earth and is also a Web Map Service client. Recently Google has revealed that Google Earth now covers more than 98 percent of the world, and has captured 10 million miles of Street View imagery, a distance that could circle the globe more than 400 times.

|| Volume 5 || Issue 12 || May 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH & ENGINEERING TRENDS
Multidisciplinary Journal
Double-Blind Peer Reviewed Refereed Open Access International Journal

3) Q-GIS: QGIS (until 2013 known as Quantum GIS) is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data.

Figure 1 Water hyacinth

Figure 2 Typical water hyacinth species in Pune River

QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps.[3] QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images.

QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats.[4] Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.[5

D. Problem statement:

Water hyacinth creates imbalance in the aquatic system, disturbs boating, transportation and touristic activities, because the water hyacinth mats the propellers. Thus it becomes necessary to remove the water hyacinth. We don't have any method to estimate the quantity and cost of water hyacinth. We need a method to estimate the quantity and cost of water hyacinth quickly.

E. Objectives:

- To assess the distribution of water hyacinth to determine the area covered by water hyacinth.
- To generate a cost-area factor to quickly estimate the cost of removal of any year with the help of GIS software.
- To propose the estimate for 2021 by the factor generated in project work.
- To propose a comprehensive strategy for the management of water hyacinth.

II LITERATURE REVIEW

Shade Dayana et al "RIVER FLOW ESTIMATION FOR UNGAGED STATIONS USING GIS MODEL"

In this research, water flow of river has been estimated in an ungagged point using ArcView. GIS has been used to calculate the physiographical characteristics of watershed, flow accumulation, flow directions, etc. Its high speed in estimating these characteristics which are lengthy in other methods, is its main advantage. The river water flow in the ungagged point was calculated using the information extracted from produced layers and water flow measurements in upstream and downstream stations.

B. Mapping distribution of water hyacinth (Eichhornia crassipes) in Rwanda using multispectral remote sensing imagery

Water hyacinth, Eichhornia crassipes (C. Mart) Solms (Pontederiaceae), is an invasive aquatic macrophyte with major negative economic and ecological impacts in Rwanda and other East African countries since its establishment in the region in the 1960s. Reliable estimates of water hyacinth distribution are required to determine the severity of the problem and identify waterbodies requiring management. Remote sensing techniques, based on the Landsat 8 sensor, offer promising alternatives to accurately detect, map and monitor the extent of the water hyacinth invasion in Rwandan waterbodies. The aim of the current study was to investigate the utility of multispectral remote sensed imagery using Random Forest and Support Vector Machine algorithms to detect and map water hyacinth in Rwandan waterbodies. Random Forest had a high overall accuracy of 85%, compared with Support Vector Machine (65%). These algorithms confirmed different levels of water hyacinth infestations in three main Rwandan rivers. Many of the wetlands along these riparian systems and most of the lakes, particularly those from the Eastern Province of the country were found to be invaded by water hyacinth. These findings would, therefore, assist government partners and policy makers to put in place sustainable methods, such as biological control, along with integrated pest management, to control the of water hyacinth invasion in Rwanda.

MAHESH A. BOTE *"Production of biogas with aquatic weed water hyacinth and development of briquette making machine" (2018)*

This paper investigates production of biogas and electricity from water hyacinth. Human activity uses longest energy source is Biomass The organic waste and industrial waste water undergoes anaerobic digestion process produces biogas which is pure and

nature friendly. It is world's highly unfavorable aquatic weed as it forms on water surface un traversable floating mats. This plant is suspended on water surface as the carbon to nitrogen ration of the plant is high it can be used for biogas production. Biogas mainly contains sixty per cent of methane. This present paper based on methane which is used as fuel for running IC engine and from that electricity can be generated. Biogas plant working model is studied and an evaluation of performance is done with respect to economy as an alternative fuel. Also the briquette making machine was developed from the waste which is obtained from biogas plant.

MD. DULAL HOSEN *"Tensile Strength of Paper Produced from Different Body Parts of Water Hyacinth" (2020)*

This paper describes production of paper from water hyacinth. As a floating aquatic plant, water hyacinth is one the quickest growing plant of this earth. Water hyacinth is considered as a lignocellulose plant and that is why the paper making process that uses in other cellulosic materials can be applied to this plant. This article was focused to check the feasibility of producing paper from water hyacinth and check which portion of the plant is suitable for producing paper. Paper was made with different parts of water hyacinth like root, petiole, leaf, stolon and whole plant. Paper made by Dry petiole and root showed better tensile strength than other body parts and various natural colored paper was possible to produce from a water hyacinth.

METHODOLOGY

A. Selection of Area

PIMPRI-CHINCHWAD AREA:

Streams in consideration as per PCMC 2019 TENDER:

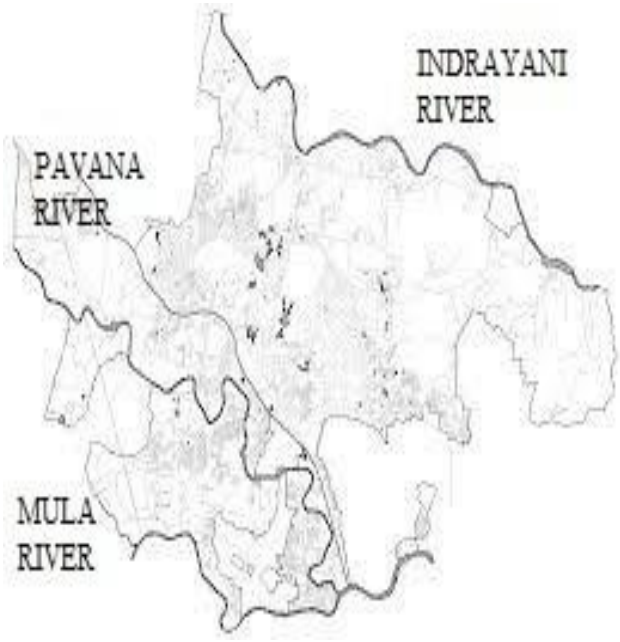


Figure 3 Rivers in PCMC

INDRAYANI RIVER: The Indrayani river originates in Kurvande village near Lonavla, a hill station in the Sahyadri mountains of Maharashtra. Concerned length of river is from I.T. PARK Nighoje Bridge till MANAPA.

PAWANA RIVER: The river originates south of Lonavala from the Western Ghats, and flows a total of nearly 60 kilometres (37 mi) to meet Mula river in Pune City. Concerned length is from **Sangavade Kavale Bridge to Dapodi.**

MULA RIVER: The Mula is a river in Pune, India. It is dammed near the Western Ghats at the Mulshi Dam that forms the Mulshi Lake. Concerned length of river is from **Vakad Bridge to MANAPA.**

Collection of data

For creating cost-area ratio previous tender of the same zone is necessary. This tender (2019-20) worked as a reference for the project. So to get the PREVIOUS TENDER of PCMC region RTI (right to information) has been done over this link (https://rtionline.maharashtra.gov.in/index-e.php) with reg.no. PCMCO/R/2021/60370.

1) RTI: The **RTI** Act 2005 covers all Central, State and local government bodies and applies to the State of Maharash- tra. RTI means that citizens can request for information from state or central government departments and offices. And such request should be processed in a timely way as mandated by the RTI Act

2) Geospatial data : After the selecion of area collecting the **Geospatial data** is the major step because there maybe chances of getting a courrpted data.So for project the data over **Google Earth** in the form of MAPS is used.

Geospatial data is information that describes objects, events or other features with a location on or near the surface of the earth. Geospatial data typically combines location information (usually coordinates on the earth) and attribute information (the characteristics of the object, event or phe- nomena concerned) with temporal information (the time or life span at which the location and attributes exist).

B. Mapping (drawing polygon layers in GOOGLE EARTH

The softwares needed are Google earth and Q-gis. For reference maps and mapping the distributions Google earth software is used whereas to calculate area Q-gis is used.

Mapping is not only done for region in consideration (as mentioned in TENDER) but also for some upstream length in each river. This is done because tender is issued for 8 month span and after certain time with flow water hyacinth from upstream is going to come in the region of consideration. Hence it is necessary to map and estimate upstream side also.

|| Volume 5 || Issue 12 || May 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH & ENGINEERING TRENDS
Multidisciplinary Journal
Double-Blind Peer Reviewed Refereed Open Access International Journal

Figure 4 Mapping water hyacinth

C. Import and Georeferencing in Q-GIS

For area calculation files from Google earth are exported to Q-GIS system WGS 84/ UTM 43 N

All the files created in Google earth are saved in the **kml/kmz file** format. After importing and georeferencing the files in Q GIS we are able to calculate the total Area of aquatic weeds over a river bed by using the tools of Q GIS.

E. Area calculation

Overall area of mapped region is calculated by using attributes of area calculation in QGIS.

F. Cost-Area ratio

After all this process the area of water hyacinth (2019) and cost of archived tender of PCMC (2019-20) through RTI is noted and Cost-Area ratio is calculated by the formula-

$$\textit{Cost – Area Ratio} = \frac{\textit{Total cost assigned in the tender}}{\textit{Total water hyacinth coverage}}$$

G. Proposing approximate cost for 2021

The cost-area ratio will be same for a particular area as this ratio majorly depends on the field factors like usage of boats, amphibious machines and shifting cost of machines. But as these factors will be same for a concerned area hence this ratio can be used for the same region for years.

I. MANAGEMENT OF WATER HYACINTH

Utilization plans do not suggest the cultivation of the plant,Since it is considered as a pest. The real challenge is not how to get rid of this weeds but how to benefit from it and turn it into a crop. The most important consideration in the utilization of water hyacinth is its high growth rate and dry matter production.
Composition of water hyacinth

Table 1

Components	% composition
1. Lignin	10
2. Cellulose	25
3. Hemicellulose	35
4. Ash	20
5. Nitrogen	03

A. Briquette

A briquette is a compressed block of coal dust or other combustible biomass material (e.g. charcoal, sawdust, wood chips, peat, or paper) used for fuel and kindling to start a fire. The term derives from the French word *brique*, meaning brick. In order to facilitate easy handling of the water hyacinth briquettes of suitable dimensions can be made.

Figure 5 Briquette

Process of briquetting:

The main procedures in the experiment are shown in Fig. The leaves were shredded into small pieces for each sample. The pieces were dried over a minimum period of 3 days and then pulverized using a pestle. A molasses binder was used to improve compactness and strength of the briquette. Various trial runs and percentage ratios were investigated to determine the amount of molasses just sufficient to bind and produce a compact briquette. A mass of 10 % molasses to organic material was found to be sufficient to produce a compact briquette. The ratio was used for all leaf sample briquettes. Briquetting was done using the hydraulic press machine in the Institute of Mining Research at the University of Zimbabwe. The mass of the samples was measured first and then mixed with the molasses binder. The mixed sample, weighing 13 g was then deposited into the holder of the cylindrical pressing machine. A weight used as a stopper was then placed on top of the biomass. The locking system on the machine ensured that the stopper would not come off. When activated, the hydraulic press machine compacted the biomass producing cylindrical briquettes.

B. Biogas

In several countries water hyacinth is successfully used for biogases production in fermentators of different capacities. They concluded that a mixture of 25% cow doing and 75% of dry water hyacinth yield best rates of methane production.

PROCESS:

There are three main steps in the digestive process: Hydrolysis Formation of acid Formation of methane.

For first stage, proteins, carbohydrates and fat converted into dissolvable substances. The acid formed from this process leads to formation of fatty acids, amino acids, and alcohol by help of acidic bacilli. The methanogic bacteria help to produce methane, hydrogen sulphide, ammonia, carbon dioxide in the third phase.

During formation of acid gives rise to fatty acids, amino acids and alcohol by acidic bacteria. Methane, carbon dioxide, hydrogen sulphide and ammonia are produced in the third phase. During the process of digestion solution becomes diluted. The digestion time is shortened as how two phases get merged successfully. The fermentation channel is arranged successfully as it is favorable for this condition According to temp in digester digestion is divided into three types

_ Psychosomatic digestion (10 _C–20, C, time longer than 100 days),

_ Mesophilic digestion (20 _C–35, C, retention time in 20 days),

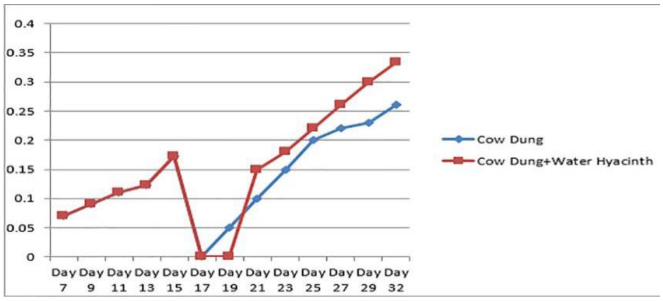
_ Thermophilic digestion (50 _C–60, C, retention time in 8 days)

The water hyacinth chopped into 5–10 cm pieces. Then this water hyacinth is fed to the digester where it is kept for 10–15 days by continuous daily feeding .After that anaerobic digestion process takes place

Preparation of waste – The cow dung was mixed with water in the proportion of 1:1 with aim to produce culture for anaerobic digestion. The cow dung was fed daily to the plant continuously charging of Digester:

Fermentation Slurry – Total feed substances which consist of organic inorganic solids and H2O. The organic manure digested which produces biogas. The digestion process does not affect inorganic manure so it will not be used and not affected. The fluid properties will be increased by adding substrate of water or urine. For the proper working of plant it is having great importance.

Biogas – After slurry formation the biogas generation will start. This biogas can used or purified further.



Production of biogas from water hyacinth +cow dunk is similar to the biogas produced from cow dunk only till 25th day but after that there's significant change as WH+cow dunk produces more biogas.

The biogas produced has higher methane content ie 45.18% which is considered as most significant content of the sample, this biogas has been upgraded by cleaning devices which **raises methane content up to 65%.**

C. Paper

The Mennonite Central Committee of Bangladesh has been experimenting with paper production from water hyacinth for some years. They have established two projects that make paper from water hyacinth stems. The water hyacinth fibre alone does not make a particularly good paper but when the fibre is blended with waste paper or jute the result is good. The pulp is dosed with bleaching powder, calcium carbonate and sodium carbonate before being heated.

The first project is quite large with 120 producers involved in paper manufacture. The equipment for pulping is relatively sophisticated and the end product is of reasonable quality. The second project involves 25 - 30 people and uses a modified rice mill to produce pulp. The quality of the paper is low and is used for making folders, boxes, etc.

Similar small-scale cottage industry papermaking projects have been successful in a number of countries, including the Philippines, Indonesia, and India.

D. Fertilizers

Water hyacinth can be used on the land either as a green manure or as compost. As a green manure it can be either ploughed into the ground or used as a mulch. The plant is ideal for composting. After removing the plant from the water it can be left to dry for a few days before being mixed with ash, soil and some animal manure. Microbial decomposition breaks down the fats, lipids, proteins, sugars and starches. The mixture can be left in piles to compost, the warmer climate of tropical countries accelerating the process and producing a rich pathogen free compost which can be applied directly to the soil. The compost increases soil fertility and crop yield and generally improves the quality of the soil.

Compost can be made on a large or small scale and is well suited to labour intensive, low capital production. In developing countries where mineral fertiliser is expensive, it is an elegant solution to the problem of water hyacinth proliferation and also poor soil quality. In Sri Lanka water hyacinth is mixed with organic municipal waste, ash and soil, composted and sold to local farmers and market gardeners.

RESULT AND DISCUSSION

The area calculated from the Q-GIS software are shown in the table given below. All the values are in Sq.m and calculated separately for the respective rivers as mentioned in the table. All the coverage areas were measured within and upstream of the boundaries of P.C.M.C area.

Ratio calculation formula:

$$\textit{Cost – Area Ratio} = \frac{\textit{Total cost assigned in the tender}}{\textit{Total water hyacinth coverage}}$$

Calculation for 2019:

Area- Cost Ratio for year 2019= (23414034)/ (2725959.677)
= 8.589 Rs/ Sq.m

Calculation for 2021:

Cost Estimation for year 2021 = (8.589 * 1819718.357)
= 15629560.97 Rs

Approximate estimate for year 2021= (15629560.97)
+ (0.05*1529560.97)
= 16411039.02 Rs

(Assume inflation to be 5%)

	Water hyacinth coverage area	in Sq.m.			
Location	2019		2021		
	Indrayani Mula	Pawna	Indrayani	Mula	Pawna
Inside the P.C.M.C. boundary	646374.346 804495.074	154186.963	178977.556	574820.081	197154.107
Upstream of P.C.M.C. boundary	162221.257 0	0	96792.425	0	0
WH in each river	1767277.64 804495.074	154186.963	1047744.169	574820.081	197154.107
Total WH of all rivers	2725959.677		1819718.357		

CONCLUSION

1) For quantification of water hyacinth

• A significant amount of water hyacinth accumulation was observed in all the three rivers selected for the area of work.

• Total hyacinth coverage for year 2019 was observed to be 2725959.677 Sq. m. and for the year 2021 was observed to be 1819718.357Sq.m.

• Previous year(2019) tenders in the Pimpri-Chinchwad area for the water hyacinth removal was obtained and the cost for the removal was approximately 2.3 crores The approximate estimated cost for the year 2021 is 16411039.02 Rs (i.e. 1.6 Crores) as the water hyacinth coverage for current year is much less as compared with coverage of the year 2019.

• Plain area-cost ratio generated for P.C.M.C. area was observed to be 8.42 Rs/ Sq.m.

• By using this factor we can estimate the water hyacinth removal for PCMC area only by finding distribution of water hyacinth in river.

2) For utilization of water hyacinth

• Water hyacinth is the least expensive and most globally available resource hence initial cost for the startup is less.

• This provides employment in the area.

• Environmental friendly process and products.

REFERENCES

Khazanov Khalilabad et al "Water Reservoir Area and Volume Determination Using Geoinformation Technologies and Remote Sensing"

•Chad Rittman "A GIS Method for Determining Volumetric Flow in a Riverine Channel"

•Archana Sarkar "RS-GIS Based Assessment of River Dynamics of Brahmaputra River in India" (2012)

•Ali Cheuk et al "Water quality assessment along Tigris River (Iraq) using water quality index (WQI) and GIS software" (2020)

•Connie "GIS spatial modeling of river flow and precipitation in the Oak Ridges Moraine area, Ontario" (2004)

•M.K.A. Kama Rudin et al "Assessment of river plan changes in Terengganu River using RS and GIS method" (2017)

•Michael F. Goodchild et al "GIS and Transportation: Status and Challenges" (2000)

•Jinjiang et al "A GIS-based generic real-time risk assessment framework and decision tools for chemical spills in the river basin" (2012)

•Jinjiang et al "Impact of grid size in GIS based flood extent mapping using a 1D flow model" (2001)

•Sandra J et al "A GIS-based approach to mapping probabilities of river bank erosion: regulated River Tummel, Scotland" (2000)

•S. Kalia "Morphometric analysis of the River Kalia sub-basin in Kanyakumari District, South west coast of Tamil Nadu, India, using remote sensing and GIS" (2014)

•Minch G. Dressed "Potential of Water Hyacinth Infestation on Lake Tana, Ethiopia: A Prediction Using a GIS-Based Multi-Criteria Technique" (2019)

•Trinidad Ruiz Tellez et al "The Water Hyacinth, Eichhornia crassipes: an invasive plant in the Guadiana River Basin (Spain)" (2008)

•J. H. EVERITT "Using Remote Sensing and Spatial Information Technologies to Detect and Map Two Aquatic Macrophytes" (1999)

•MAHESH A. BOTE "Production of biogas with aquatic weed water hyacinth and development of briquette making machine" (2018)

•MD. DULAL HOSEN "Tensile Strength of Paper Produced from Different Body Parts of Water Hyacinth" (2020)