

The background of the slide is a photograph of a vast field of water hyacinth. The plants are a vibrant green, with many small, light purple flowers scattered throughout. In the far distance, a bridge with multiple arches spans a body of water under a clear blue sky.

# Water Hyacinth

---

A study on its environmental  
impact and management.

## Summary

Water hyacinth (*Eichhornia crassipes*) is one of the world's most invasive aquatic plants and is known to cause significant ecological and socio-economic effects. Though it is native to South America, but now a days it has become an environmental and social challenge throughout India. It adversely affects the environment and humans in diverse ways. This study highlights the environmental challenge posed by water hyacinth on fresh water sources such as river & lakes in Surat District and investigate the reason of high growth, & problems caused by it. We have highlighted several ways to control its growth and utilization in this study.

## Introduction

Originally from South America, water hyacinth, *Eichhornia crassipes* is one of the world's most prevalent invasive aquatic plants. Water hyacinth, a free-floating vascular plant, is known to cause major ecological and socio-economic changes. It commonly forms dense, interlocking mats due to its rapid reproductive rate and complex root structure. Water hyacinth reproduces both sexually and asexually. Seeds generally germinate within six months, with dry conditions promoting germination. Low nutrient concentrations and temperature (air and water) are considered the strongest determinants for water hyacinth growth and reproduction.

Water hyacinth has invaded freshwater systems in over 50 countries on five continents and, according to recent climate change models, its distribution may expand into higher latitudes as temperatures rise. Water hyacinth is especially pervasive throughout Southeast Asia, the south-eastern United States, central and western Africa and Central America. It is prevalent in tropical and sub-tropical waterbodies where water nutrient concentrations are often high due to agricultural runoff, deforestation and insufficient wastewater treatment. There is not a clear record of how, why and when water hyacinth was introduced to waterbodies outside of its native range, but many populations are well established and persistent despite control efforts.

The spread of the fast-growing water hyacinth weed in Tapi River (Also known as Tapti River) and other open water sources is threatening the city's main water supply. Environmentalists blame the spread of the weed on the discharge of effluent, particularly raw sewage, into the River, Lake and its tributaries. The weed has spread, to many other water bodies throughout Surat City of Gujarat. The



plant grows rapidly and produces enormous amounts of biomass. Due to its flat top leaf structure, it covers extensive areas of open waterways.

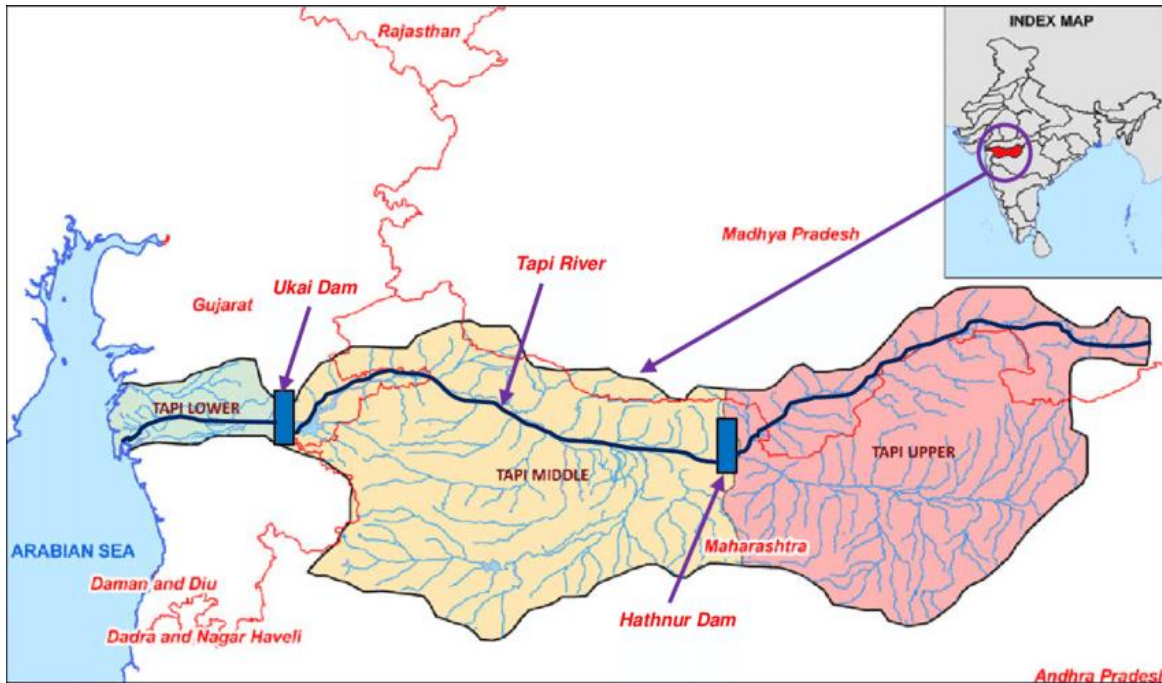


Figure 1. Map of Tapi Basin.

Surat is a large city beside the Tapi River in the West Indian state of Gujarat. According to the 2011 India census, the population of Surat is 4.5 million. The city is located on the banks of the Tapi River, and was a major port during the British colonial era. The Tapi River (or Tapi) is a river in central India between the Godavari and Narmada rivers. It flows westwards over a length of 724 km (449.9 mi) before draining through the Gulf of Khambhat into the Arabian Sea. Due to damming projects, the Tapi River become unnavigable and a new port was constructed downstream at the suburb of Hazira. It flows westwards over a length of 724 km (449.9 mi) before draining through the Gulf of Khambhat into the Arabian Sea.

The Ukai Dam, constructed across the Tapi River, is the second largest reservoir in Gujarat after the Sardar Sarovar. It is also known as Vallabh Sagar. Constructed in 1972, the dam is meant for irrigation, power generation and flood control. The storage capacity of Ukai dam is almost 46% of the total capacity of all the other existing dams in Gujarat if put together. Thus it can be concluded that the rest of the dams have as little as 0.1% average storage capacity. During the last 40 years, the actual irrigation potential is attained through all the major and medium water resources projects in the State, which comprises only 14 million hectares.



Figure 2. Tapi River near Varachha, Surat.

The effects of dams on rivers can have dramatic consequences both upstream and downstream as the natural flow and drainage of the land is altered. One of the most obvious of these effects is a profound altering of the natural sediment load carried by the waters of the previously free-flowing river. One of the adverse effects of dams that has been poorly understood until quite recently is the impact the fragmentation of watercourses has had on riverine ecosystems. The interconnected ecologies of riparian environments are profoundly altered as the cycles and rhythms of the natural flow of rivers are interrupted. Plant and animal populations are thrown out of all balance as invasive species move into the

disrupted riparian ecologies and native species are displaced, reduced and in some cases eradicated.

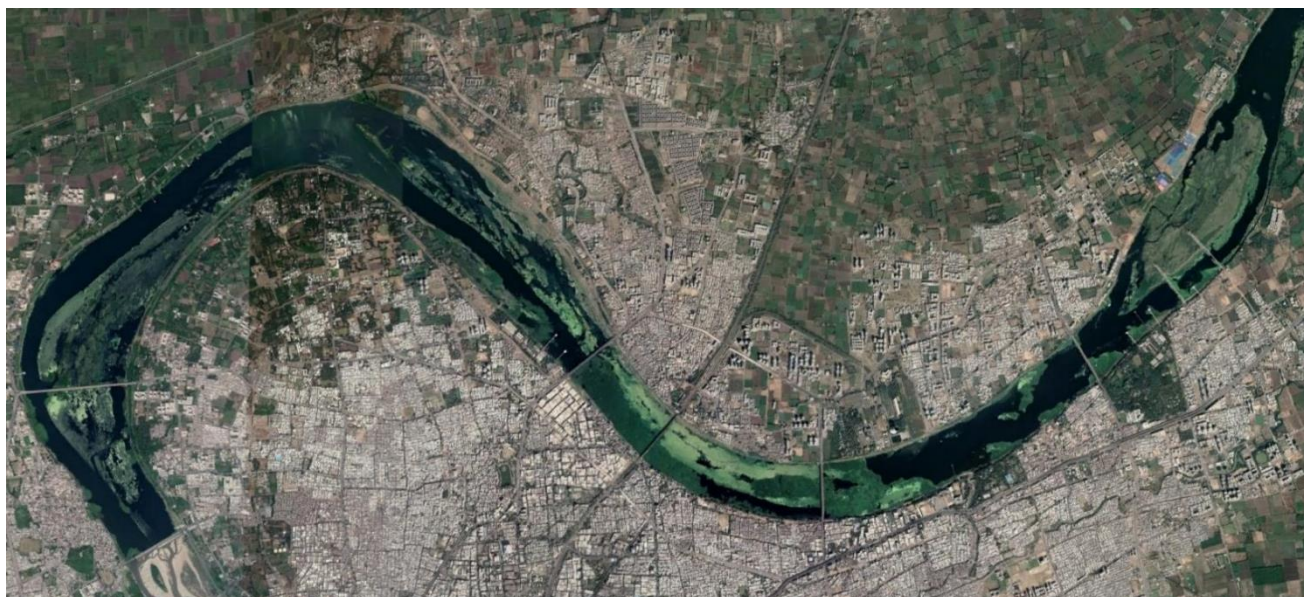


Figure 3. Google Map image highlighting hyacinth cover in Tapi river.

Stagnant water and sewage flowed in Tapi River has played adverse role in growth of water hyacinth. Major affected areas by water hyacinth lies between Kamrej and Weir-cum Causway. Almost 60% of river is covered by water hyacinth in this area. Surat Municipal Corporation, political parties and NGOs are undertaking removal of water hyacinth from several areas but the man power is not sufficient for manual removing and removal is just the temporary solution. Finding the main cause of growth and eradicating it only proper solution. Removed water hyacinth can be utilized in many different ways such as, fertilizer, fodder for animals, paper production, briquette making, etc.



# Water Hyacinth

## What is water hyacinth?

Water hyacinth is a perennial aquatic herb (*Eichhornia crassipes*) which belongs to the family Pontedericeae, closely related to the Liliaceae (lily family). The mature plant consists of long, pendant roots, rhizomes, stolons, leaves, inflorescences and fruit clusters. Water hyacinth consist of a free-floating rosette of shiny rounded leaves with thick masses of feathery roots which hang in the water. The roots are dark in colour and can reach 2.5 m in length.



**Figure 4. Water Hyacinth Plant Structure.**

### **Life Cycle of water hyacinth**

Usually germination in this plant starts between September & December. Perennial crown persist through autumn and winter. Flowering can begin as early as October and continue through the summer months. Each of the flowers on a stalk remain open for one to two days before beginning to wither. When all the flowers on a plant have withered, the stalk gradually bends into the water. Seeds are released from capsules at the base of each dead flower after about 18 days. In warm climates, vegetative reproduction is rapid and enables the formation of large, dense rafts of plants within a short time.

### **Habit**

Water hyacinth is a perennial aquatic herb that can grow in still or slow-flowing fresh water in tropical and subtropical climates, and even in temperate regions with milder winters. Its optimum growth occurs between 28°C and 30°C, and requires abundant nitrogen, phosphorus and potassium. However, it can tolerate a wide range of growth conditions. It is widely prevalent in tropical and subtropical waters enriched by agricultural runoff, untreated wastes and deforestation. It is especially pervasive in Southeast Asia, the southeastern United States, central and western Africa and Central America due to suitable growing conditions and the lack of natural predators.

### **Habitat**

Water hyacinth prefers still or slow-moving freshwater systems such as ponds, dams, lakes, rivers and wetlands. Plants require a body of water to establish and spread, but can also survive for many months on damp soil where water levels have receded. While it does require optimal conditions for rapid growth and spread, it is able to withstand a wide range of climates and conditions.





actual course of its spread is poorly documented. In the last 10 years the rapid spread of the plant in many parts of Africa has led to great concern.

### **Reproduction**

Water hyacinth can reproduce from both seed and vegetative growth. Under favourable conditions, water hyacinth is capable of growth and reproduction all year round, although flowering mostly occurs during spring and summer months. Seeds are typically responsible for reinvasion of an area already treated. New plants can flower within 3-4 weeks, producing thousands of seeds that are released into the water. The small seeds sink to the muddy bottom where they can remain dormant for up to 20 years. Once the water body has refilled, seedlings break free from the mud and float to the water surface, quickly developing a new root system.

### **Dispersal**

Throughout a catchment, the greatest method of dispersal is from the movement of plants during periods of high water flow and flooding. Large floating mats can break up and move to new areas within a catchment, and then rapidly increase in size from vegetative growth. A single plant can begin a new infestation. Seeds can be responsible for the introduction of water hyacinth into a new area, which may be moved by water or from contaminated mud stuck to birds, machinery or footwear. Birds may also be capable of moving small plants from dams and ponds into nearby waterways. Most spread has been the result of human activity, such as deliberate plantings and dumping of unwanted plants into waterways and possesses the greatest risk of developing new infestations.

## The Problem

Water hyacinth (*Eichhornia crassipes*) is one of the world's most serious water weeds because of its aggressive fast-growing nature. Plants can form dense mats that reduce the water quality, change water flows and increase sediment. Water hyacinth crowds out native aquatic plants and animals, altering ecosystems, destroying habitats, and blocking irrigation systems. Water hyacinth has been identified by the International Union for Conservation of Nature (IUCN) as one of the 100 most aggressive invasive species and recognized as one of the top 10 worst weeds in the world. It is characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance. Under high nutrient water levels, the growth of water hyacinth is dramatic, where it can quickly cover the entire water surface. Submerged plant communities are affected by the thick floating water hyacinth mats, as they block sunlight and absorb large amounts of nutrients that are required by these organisms to photosynthesise. This destruction of native habitat can lead to decreased fish, aquatic invertebrate and water bird populations as the availability of food diminishes.

Water quality is affected in a number of ways following water hyacinth invasion. Dissolved oxygen levels are reduced beneath the floating mat by decreasing the natural transfer of oxygen from the air at the water surface. In addition, decomposing dead plant material can further reduce the amount of dissolved oxygen and increase the amount of sedimentation and silting in the water. All of these factors lead to a decrease in water quality. The amount of water lost from a water body by a water hyacinth infestation can be up to three times larger than the natural evaporation rate of an uncovered water surface. These high levels are the result of high transpiration rates water lost through the



leaves. This can have large impacts on water storages with infestations of water hyacinth and river systems that may already be low on water.

Water hyacinth mats can be dangerous for recreational users of water and stock which may become tangled in the roots and stolon of plants if venturing into the water. Mats may provide a breeding ground for mosquitos which can carry disease such as Ross River virus and Dengue fever. Bulk removal and stockpiling of harvested water hyacinth material that contains heavy metals may also pose a small risk if not managed correctly.

Water hyacinth can cause a variety of problems when its rapid mat-like proliferation covers areas of fresh water. Some of the common problems are listed below:

1. Blocking/Clogging of irrigation canals & rivers.
2. Destroying natural wetlands.
3. Reducing infiltration of sunlight.
4. Destruction of biodiversity.
5. Increasing water loss through transpiration. (Greater than evaporation from an open water body.)
6. Micro-habitat for a variety of disease vectors.
7. Problems in water transport.
8. Threat related to ecosystem.
9. Threat related to economic impact.

Tapi River is also facing many issues because of water hyacinth. Water hyacinth creates filth in Tapi River water and also damages machinery of intake wells used

for fetching drinking water for the city. Since years, the problem has continued without any permanent solution, despite huge spending by SMC. The reason for the growth of vegetation is reduced water level in Tapi River. More than 14 outlets (Actual number might be more than 40 as all are not visible or accessible) in the upstream of the river starting from weir-cum-causeway to Kamrej throw all kinds of sewage into the riverbed. When water level is low, the sewage acts as nutrition for weeds and help water hyacinth to grow faster.

Sewerage contaminating in water bodies increases nutrient levels in the water. This encourages growth of aquatic plants. The water hyacinth is a floating aquatic microphyte that grows rapidly in sewage contaminated or eutrophic lakes. It steals nutrition needed by other submerged plants and micro-organisms. The thick weed cover obstructs the penetration of sunlight into the lake's ecosystem, affecting ecological balance. Surat Municipal Corporation (SMC) in the last one year closed more than eight outlets that released raw sewage into Tapi, yet there is hardly any improvement in the quality of water of the river and it continues to be highly polluted. The reason is 380 million liters per day (MLD) of sewage from 11 villages under the Surat Urban Development Authority (SUDA) area and industrial waste continue to be released into the river. All this polluted water and raw sewage gets settled on base of river. There are 19 intake wells between Weir-cum causeway & Kamrej. All this intake wells are situated very close to the sewage outlets, therefor groundwater collected by this mixture of polluted water and sewage. Lack of proper planning in wastage and sanitation management by Surat Municipal Corporation is the main cause for sewage thrown in Tapi. There are several water treatment plant for purification of water run by SMC but the treatment and quality of purified water is questionable. Besides all this ashes and treated (polluted) water from Ukai Thermal power station is flown in Tapi River.





**Figure 6. Tapi River bed covered by water hyacinth.**



**Figure 7. Sewage flow in Tapi River.**





Figure 8. Polluted water flowing in Tapi River from sewage outlet.

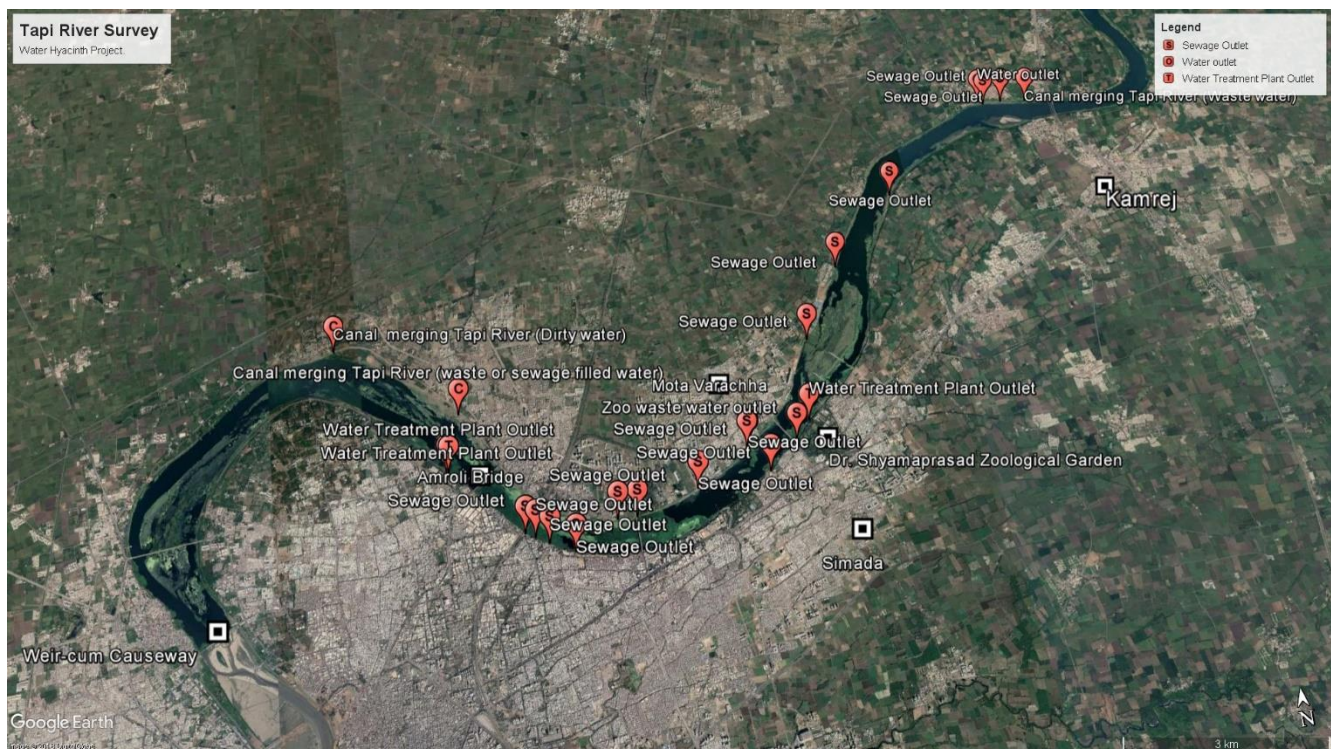


Figure 9. Map of sewage outlet & canals merging in Tapi River.





Figure 10. Nineteen intake wells on Tapi River.



Figure 11. Polluted water flowing in Tapi from a sewage outlet near Uttran Power Station.





Figure 12. Google Earth Image of Ukai Thermal Power Station (Green Highlighted Area).



Figure 13. Polluted/treated water flowing in Tapi from Ukai Thermal Power Station.



# Control mechanisms for preventing the spread of, or eradication of, water hyacinth.

## Prevention and early detection

- Check high risk areas, including ponded or slow-moving water bodies, and areas close to human activity and urban development.
- Control new infestations as quickly as possible.
- When using water facilities make sure any related equipment is free of plant material prior to leaving.
- Community education to increase awareness, capacity for early detection and decrease the plants ornamental use.

The 3 main mechanisms used are biological, chemical and physical control. Each has its benefits and drawbacks. Chemical control is the least favored due the unknown long-term effects on the environment and the communities with which it comes into contact. Physical control, using mechanical mowers, dredgers or manual extraction methods, is used widely but is costly and cannot deal with very large infestations. It is not suitable for large infestations and is generally regarded as a short-term solution. Biological control is the most widely favored long-term control method, being relatively easy to use, and arguably providing the only economic and sustainable control. Below we will briefly discuss each of these methods.

## Biological control

Biological control is the use of host specific natural enemies to reduce the population density of a pest. Several insects and fungi have been identified as control agents for water hyacinth. These include a variety of weevils, moth and

fungi. Biological control of water hyacinth is said to be environmentally benign as the control agents tend to be self-regulating agents

Water Hyacinth Intermediate Technology Development Group usually inexpensive due to the fact that the control agents are known and only a small numbers of staff are required to run such programs. One major drawback is that it can take a long time to initiate such projects because it can take several years for the insect population to reach a population density sufficient to tackle the pest problem. In Kenya work is being carried out on the development of a biological herbicide from a locally found fungal pathogen self-regulating



Figure 14. *Neochetina eichhorniae* (Weevil)



*Niphograpta albiguttalis* (Weevil)

### Physical control

For manually removing involves water hyacinth by hand or with rakes and pitchforks or nets from a water body. It is best suited for:

- Small plant numbers that are in the early stages of an infestation,
- The removal of plants in small, confined areas such as garden ponds, small
- dams or drains,

- Small numbers of scattered plants that are growing in shallow water or along the edges of a waterway, and
- Follow-up to chemical or mechanical control to remove floating or newly germinated seedlings.



Figure 15. Manual removal of water hyacinth by Surat citizens.

Mechanical removal of water hyacinth requires purpose built aquatic weed harvesters that can either remove the bulk of the plant material from the water surface or break thick mats apart and move them closer to the bank for removal by an excavator or other similar machinery. Limitations of mechanical removal:

- High equipment costs compared to chemical control
- Some machinery is not suitable for shallow water or areas with accessibility issues or highly sensitive vegetation.
- Time consuming.
- Labor intensive.





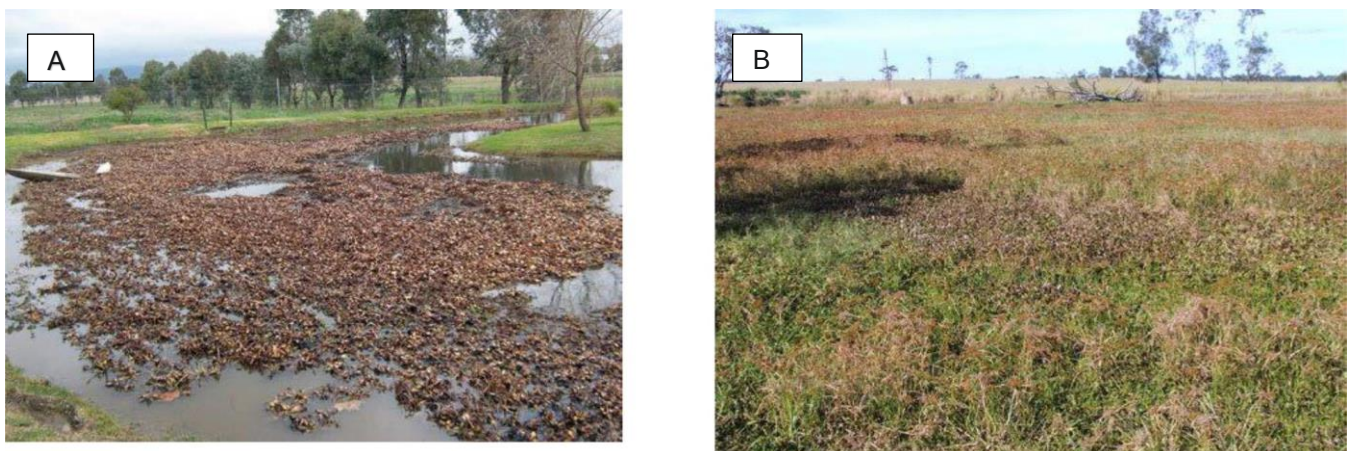
Figure 16. Manual removal of hyacinth by Surat Municipal Corporation using boats.



Figure 17. Mechanical removal of water hyacinth by De-weeder/ Weed harvester (SMC).

## Chemical Control

The application of herbicides for controlling water hyacinth has been carried out for many years. The common herbicides are 2,4-d, Diquat and Glyphosate. It has been found that there is a good success rate when dealing with small infestations but less success with larger areas. Application can be from the ground or from the air and requires skilled operators. As mentioned earlier the main concern when using herbicides is the environmental and health related effects, especially where people collect water for drinking and washing. All registered herbicides are applied as a foliar spray on actively growing plants. Correct application, To get the best results from herbicides, it is important that they are applied as a foliar spray at the correct rate, at the right stage of plant growth and that complete herbicide coverage of the plant is achieved. Timing of applications, herbicides should be applied before flowering to young green material that is experiencing active growth. Plants experience most growth during the spring and summer months, with flowering normally starting early autumn



**Figure 18. (A) Water hyacinth after spray with diquat, note some green petioles are appearing. (B) After aerial spray, note some water hyacinth was shielded from the herbicide by other vegetation.**





Figure 19. Boat with spray unit, used to spray herbicides.

Figure 20. Sprinkler system  
Used to spray herbicides in  
Lakes



Besides these three mainstream forms of control Harley, Julien and Wright suggest another method, namely the reduction of nutrient inputs to the water. this is a preventative method, it can be argued that a reduction in nutrients in the water body will result in a reduction in the proliferation of water hyacinth. In recent decades there has been a significant increase in the level of nutrients dumped into waterways from industrial and domestic sources such as sewage and polluted water.



## Possible Utilization

This plant contains 95% of water. It has fibrous tissue and a high energy and protein content, and can be used for a variety of useful applications. It can also be used to aid the process of water purification. Below we will consider a number of possible uses for the plant, some which have been developed and others which are still in their infancy or remain as ideas only.

### Handicraft

Eco-friendly handicraft are trend in this new era. Extensive use of cane & bamboo has nearly exhausted imposing a threat to traditional cane and bamboo sector region. Thus, the very idea to promoting rural livelihood and managing resources at the same time has prompted “North Eastern Development Finance Corporation Limited” to think about smart alternatives which resulted in identifying Banana Pseudo-Stem & Water hyacinth as the Raw Material. They have achieved a milestone in making handicraft from water hyacinth. They have provided a new employment to rural people. Products made from water hyacinth are sold between 500 - 20,000 rupees on Amazon.in.



Figure 21. Exhibition of handicraft made of water hyacinth.



Jacket made of Water Hyacinth



Figure 22. Handicraft made of Water Hyacinth.

### Making 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 fiber alone does not make a particularly good paper but when the fiber 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. A notebook made of water hyacinth sold at \$1-10 on Alibaba.com.



Figure 23. Notebook, envelop and pages made of water hyacinth.

### Charcoal Briquetting

The decreasing availability of fuel wood, coupled with ever rising prices of kerosene and cooking gas in Nigeria, has necessitated a consideration of alternative sources of energy for domestic and cottage level industrial use in the country. This is an idea which has been proposed in Kenya to deal with the rapidly expanding carpets of water hyacinth which are evident on many parts of Lake Victoria. The proposal is to develop a suitable technology for the briquetting of charcoal dust from the pyrolysis of water hyacinth. The project is still very much at the idea stage and both a technical and a socio economic study are planned to evaluate the prospects for such a project. It is suggested that small-scale water hyacinth charcoal briquetting industry could have several beneficial aspects for the lakeside communities. However, for a plant to produce 40 tons per day of briquettes an area of 12 hectares would be required for drying the water hyacinth, 1,300 tonnes of wet hyacinth would be required daily and the climate would need to be one of low humidity and relatively high temperature.



Figure 24. Briquettes made of water hyacinth.



### Animal fodder

Studies have shown that the nutrients in water hyacinth are available to ruminants. In China pig farmers boil chopped water hyacinth with vegetable waste, rice bran, copra cake and salt to make a suitable feed. In Malaysia fresh water hyacinth is cooked with rice bran and fishmeal and mixed with copra meal as feed for pigs, ducks and pond fish. In Malaysia fresh water hyacinth is cooked with rice bran and fishmeal and mixed with copra meal as feed for pigs, ducks and pond fish. Similar practices are much used in Indonesia, the Philippines and Thailand. The high water and mineral content mean that it is not suited to all animals. The use of water hyacinth for animal feed in developing countries could help solve some of the nutritional problems that exist in these countries. Animal feed is often in short supply and although humans cannot eat water hyacinth directly, they can feed it to cattle and other animals which can convert the nutrient into useful food products for human consumption.



Figure 25. Water hyacinth fed to cattle.

## Biogas

The possibility of converting water hyacinth to biogas has been an area of major interest for many years. Conversion of other organic matter, usually animal or human waste, is a well-established small and medium scale technology in a number of developing countries, notably in China and India. The process is one of anaerobic digestion which takes place in a reactor or digester (an air tight container usually sited below ground) and the usable product is methane gas which can be used as a fuel for cooking, lighting or for powering an engine to provide shaft power. The residue from the digestion process provides a fertilizer rich in nutrients. NASA has demonstrated that each 2.2 lbs. of water hyacinth (dry weight) yields about 83 gallons of biogas, with an average methane content of 69 per cent. Studies reported in m<sup>3</sup> of biogas per m<sup>3</sup> of digester per day, has been 0.52 during the warm season and 0.29 during the cool season. Although the yields have been quite satisfactory, they can be improved by applying the appropriate pretreatments. The facility can save 7.3 tons of firewood per year. Promoting the use of biogas will contribute to the fight against desertification. Using the water hyacinth as a substrate for the production of biogas is an advantageous control strategy because it permits a “productive fight” against the plant’s invasion.

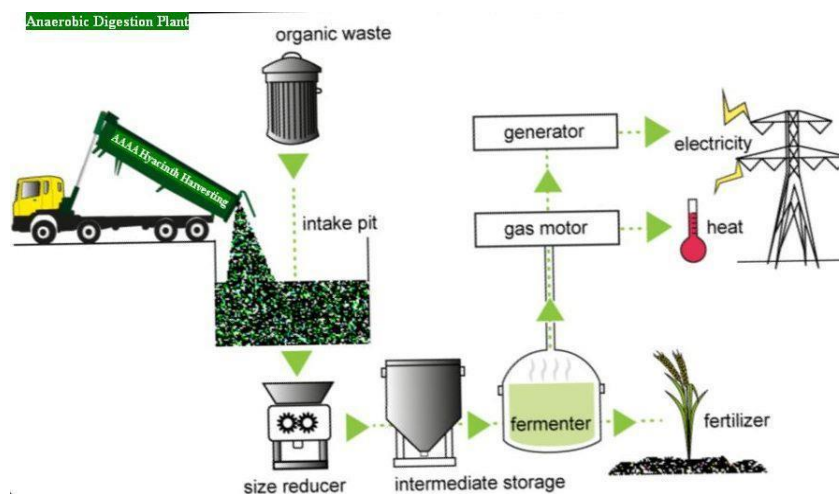


Figure 26. Process of making biogas from water hyacinth.

## 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.

## Scalable, Adaptable, and Local

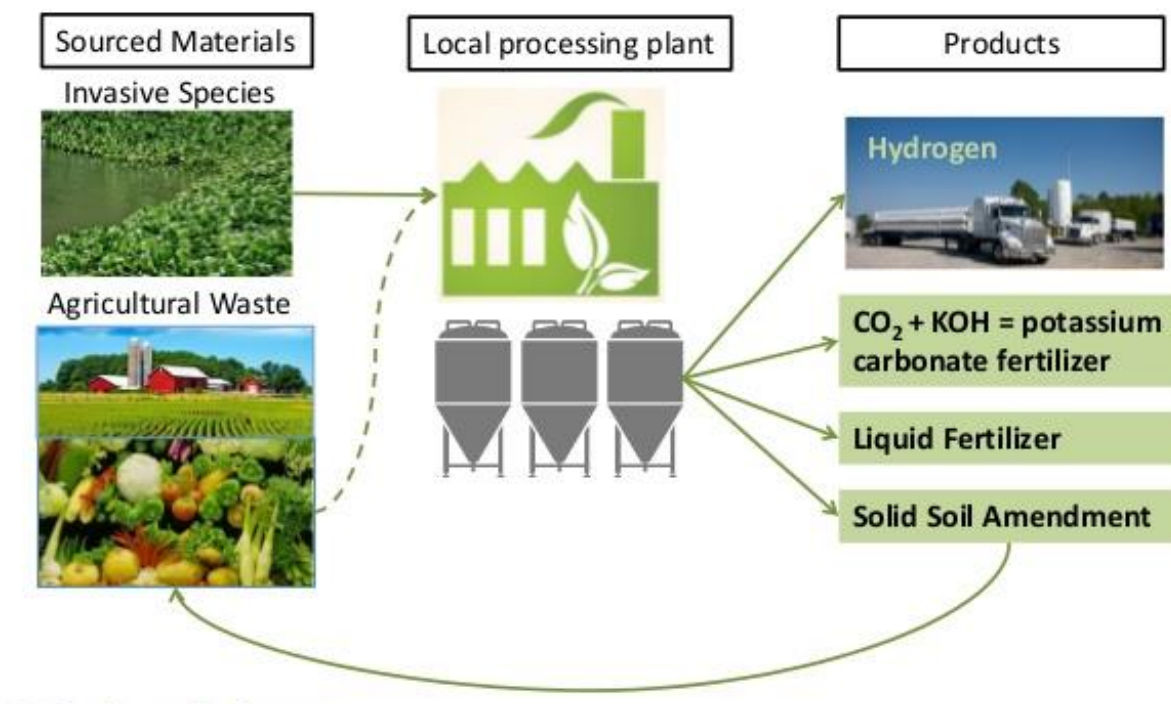


Figure 27. Process of making fertilizer from water hyacinth.



## Water Purification

Water hyacinth can be used to aid the process of water purification either for drinking water or for liquid effluent from sewage systems. In a drinking water treatment plant water hyacinth have been used as part of the pretreatment purification step. Clean, healthy plants have been incorporated into water clarifiers and help with the removal of small flocs that remain after initial coagulation and floc removal or settling. The result is a significant decrease in turbidity due to the removal of flocs and also slight reduction in organic matter in the water.



Figure 28. Duckweed Wastewater Treatment Plant near Kunming, China.

Water Hyacinth Intermediate Technology Development Group the plants grow quickly and can be harvested to provide rich and valuable compost. Water hyacinth has also been used for the removal or reduction of nutrients, heavy metals, organic compounds and pathogens from water in controlled situation.

### **Fiber Board.**

Another application of water hyacinth is the production of fiberboards for a variety of end uses. The House and Building Research Institute in Dhaka has carried out experimental work on the production of fiber boards from water hyacinth fiber and other indigenous materials. They have developed a locally manufactured production plant for producing fiberboard for general-purpose use and also a bituminized board for use as a low cost roofing material.

The chopped water hyacinth stalks are reduced by boiling and then washed and beaten. The pulp is bleached and mixed with waste paper pulp and a filter agent such as china clay and the pH is balanced. The boards are floated in a vat on water and then finished in a hand press and hung to dry. The physical properties of the board are sufficiently good for use on indoor partition walls and ceilings. Investigations into the use of bitumen coated boards for roofing are underway.

### **Yarn and Rope.**

The fiber from the stems of the water hyacinth plant can be used to make rope. The stalk from the plant is shredded lengthways to expose the fibers and then left to dry for several days. The rope making process is similar to that of jute rope. The finished rope is treated with sodium metabisulphite to prevent it from rotting. In Bangladesh, the rope is used by a local furniture manufacturer who winds the rope around a cane frame to produce an elegant finished product.



## Basket Work

In the Philippines water hyacinth is dried and used to make baskets and matting for domestic use. The key to a good product is to ensure that the stalks are properly dried before being used. If the stalks still contain moisture then this can cause the product to rot quite quickly. In India, water hyacinth is also used to produce similar goods for the tourist industry. Traditional basket making and weaving skills are used.



Figure 29. Baskets made of water hyacinth.

## Discussion

Surat Municipal Corporation, political parties, universities, media and Surat citizen has started taking the issue of water hyacinth seriously. Since November 2017 there's sudden rise in awareness among adverse effects caused by water hyacinth to Tapi River and common man. Various campaigns were started to clean Tapi River from water hyacinth. This types of campaigns plays an important role to keep up the momentum. Social media, printing media and digital media have played important role in spreading the words. Due to awareness among local populace Surat Municipal Corporation has increased their efforts in removing water hyacinth. However, removal of water hyacinth is just a temporary solution. Sewage and polluted water thrown to river will act as nutrition to water hyacinth thus, it will regrow within few weeks. Until and unless this sewage outlets are not stopped merging in Tapi River this problem will never end. Sewage contains pathogen which plays important role in growth of water hyacinth. This pathogen cannot be treated in any ways so, it is good to make a better waste management and stop sewage flowing into Tapi River. Usually in small & stagnant water bodies like lakes and pond, Water hyacinth absorb all the nutrition from water body but once there is no nutrition left, it dies naturally due to lack of nutrition. Thus the natural cycle continues. Here main problem is Weir-cum causeway, because of it Tapi River is almost blocked and stagnant water plays role of breeding ground to water hyacinth. Studies has proved that if the water is flowing, chances of water hyacinth growth would be really less.

Removed water hyacinth was usually left at river bank which use to go pack in water during monsoon. Now a days SMC has started dumping water hyacinth to several sites and using it for land filling. Water hyacinth can be utilized in better way if it is sun dried. Above we have stated various ways to utilize water hyacinth.



Making handicraft, paper making and charcoal briquettes can be implemented in Surat as they are tested ways to utilize water hyacinth. Surat Municipal Corporation should make a proper committee to work on control and utilization of water hyacinth. All stake holders should come to a common platform figure out a proper solution to this serious issue.



Figure 30. Tapi Clean up drive undertaken by SMC, Political parties and citizens.

# નદીની દુર્દશા માટેનું એક કારણ મનાતી જળકુંભીની જડ ઉખેડવી જરૂરી 90 સ્થળે ગટરનાં પાણી તાપીમાં ઠલવાય તો જળકુંભી થાય જ ને!



**ભેલજી | સુરત :** પાર્શ્વિક મહત્ત્વ ધરાવતી તાપી મેયાની અત્યારે એટલી દુરુણ અને કુદરૂણ હાલત છે કે એક સમયે બે કદી વહેતી તાપી મેયા આજે ગટરનાં પાણીથી માત્ર દરોક ફૂટ જેટલી વહે છે. કદો કે સુકાઈ રહી છે. તેના સુદ્ધિકરણ માટે હવે રીડી રીડીને અભિયાન શરૂ કરાયું છે પરંતુ બગાડ એટલો થયો છે કે સુદ્ધ કરારે ઘસો તે ભગવાન જ જાણે!

**કોઝવેને કારણે હેઠવાસમાં તાપી ગટર બનીને રહી ગઈ**

શાલમાં કોઈ પણ પવિત્ર નદી તરીકે જેની ગણતરી કરી છે તે પુષ્પવતીલા તાપી વિશે કોઝવણું છે કે ગંગાજીમાં સ્નાન કરવાથી, યમુનાપુત્રનું પાન કરવાથી, નર્મદાજીના કદાન કરવાથી અને તાપી મેયાનું સ્મરણ કરવા માયત્રી પાપનો નાશ થાય છે. આનું અનંતુ પાર્શ્વિક મહત્ત્વ ધરાવતી તાપી મેયાની અત્યારે ભેરોળી દુરુણ અને કુદરૂણ હાલત છે કે એક સમયે બે કદી વહેતી તાપી મેયા આજે ગટરનાં પાણીથી માત્ર દરોક ફૂટ જેટલી વહે છે. કદો કે સુકાઈ રહી છે. ત્યારે સવાય એ ઊંડે છે કે તાપી મેયાની આવી હાલત શા માટે થઈ આવી હાલત કરવા પાછળ કોણ જવાબદાર હવે તાપી મેયાને પુનઃ જળપ્રવાહ વહેતી કરવા માટે શું કરવું જોઈએ આ અને આવા અનેક પ્રશ્નોને લઈને 'દિવ્યભાસ્કર' વાંચી એ વખત સામર્પિત ઉદાગોષ્ઠિનિર્માણના માટે સુધી મેયાનો અભિયાનનો પ્રારંભ કરવા પડ્યો હતો. જેમાં કોઝવેની કદી પણ વ્યક્તિ તાપી મેયા પ્રતિ પોતાનો અદર બક્ષત કરવા માટે સામર્થ્ય થઈ ગઈ છે.



છેલ્લાં બે વર્ષથી જળકુંભીએ તાપી નદી પર રીડર કમ્પાઉ જળાવી લીધો છે. નદી જાણે સુકાઈ હોય તેવું નાસ્તે પડે છે. **શ્રદ્ધાભાસ્કર**

**436 માર્દલમાં વહે છે તાપી મેયા**  
તાપી મેયાનું ક્રેપન આન સાતરડા પવિત્ર છે. જેમાં મેનુષ્ય ઈશ્વરના મુલાકાત ગણીને તરવેનો પ્રાર્થના થાય છે. તે હેઠ પ્રભુ નજર કરીશમાં ભવે છે ત્યાં સુધી તેની લંબાઈ 436 માર્દલ થાય છે. તાપી મેયામાં કુલ 9 નદીનાં પાણી ભળે છે. તાપી વટે કુલ 108 ઈશ્વરમંદિરો વિસ્તારના છે. તેઓ ઉભોય તાપી પુરાણમાં જોવા મળે છે.

## અભિયાન | વાડ જ ચિલ્ડાં ગળે ત્યાં ફરિયાદ કોને કરવી? તાપીમાં ખુદ મનપા જ દર સેકન્ડે 3,404 લિટર ગંદુ પાણી ઠાલવે છે

સુરત | વાડ જ ચિલ્ડાં ગળે કે જમાદાર જ ગુનો કરે તો સાબવાની જવાબદારી મનપા તંત્રની છે. તે સ્વચ્છ શાખાની વાત અને ભલા કોણ પુછે ભલે આવી જ કંઈક હાલત છે સુરત પર તો પ્યાન ક્રિસ્ટિન કરતા જ નવી ઊલટાનું તાપી નદીને ગદી મહાનગરપાલિકાની. કારણ કે તાપી નદીને સુદ્ધ અને સ્વચ્છ કરવામાં કોઈ કસર છોડતું નથી.

**શહેરભરની ગટરોની ગંદકી ઠાલવવા મહાપાલિકાએ બનાવેલા 44 આઉટલેટ પૈકી 27માંથી ગંદુ પાણી સીધે સીધું નદીમાં ભળે છે**



આમ એટલા માટે કદી રાકાય તેમ છે કે મનપાનું તંત્ર પ્રતિ સેકન્ડ પાંચ, પાંચ લીટર નદી પાંચ 3,404 લીટર મનપાનું ગંદુ પાણી તાપીમાં ઠાલવે છે! અન્ય કોઈ વ્યક્તિ કે સંસ્થા જો તાપી નદીમાં ગંદકી ઠાલવે તો તેને દંડ 82 કરવાની કામગીરી મનપાનું તંત્ર કરે છે પણ ખુદ મનપાનું તંત્ર જ જો તાપીમાં ગંદુ પાણી ઠાલવે તો તેને કોલે દંડ 82 કરે તાપી નદીમાં ગંદુ પાણી ઠાલવવા માટે મનપા તંત્ર દ્વારા સમયાંતરે કુલ 44 આઉટલેટ બનાવવામાં આવ્યા હતા. જેમાંથી હાલ 27 આઉટલેટ ચાલુ અને 17 બંધ છે. જે આઉટલેટ ચાલુ છે તેમાંથી દર સેકન્ડે 3,404 લીટર ગંદુ પાણી તાપીમાં ઠાલવાઈ રહ્યું છે. જેના કારણે તાપી નદીની હાલત દિન પ્રતિદિન બગાડી જાય છે. વાંચ ને વાંચ ગેદી મનપાની ચાલુ છે. તાપી નદીને સ્વચ્છ બનાવવી હશે તો સોંધી પહેલા મનપાના તંત્ર દ્વારા ઠાલવવામાં આવતા ગંદુ પાણીને બંધ કર્યા વગર છુટ્ટો નથી. આ ગંદા પાણીના કારણે જ જળકુંભીની સમસ્યાનું નર્તન થતું છે. જેમાં સુધી ગંદુ પાણી બંધ કરવામાં નથી આવે ત્યાં સુધી જળકુંભીનો નાશ કદી રાકાય તેવી કોઈ સ્થિતિ નથી.



**સ્વચ્છતા અભિયાન માત્ર કોટા સેશન પુરતું જ રહે છે**  
સમયાંતરે મનપાનું તંત્ર લાજપાના બંદરે જાણે કે ગાંધી હોય તેમ બરેલર તાપીની શુદ્ધ કરવામાં ભલે સ્વચ્છતા અભિયાનના નામે કોટી સેશન કરી કામગીરી પૂર્ણ થયેલી જાહેર કરે છે. સમયાંતરે આ રીતે સ્વચ્છતા અભિયાનના નામે નાંક કરી કામગીરી પર કામગીરી બતાવે છે વાસ્તવમાં અવારનું વારી કોઈ પરિણામ સાંપડ્યું હોય તેવું વિચર જોવા મળ્યું નથી.

**22% પાણી જળકુંભી શોષી લે છે, જળચર પ્રાણીને પણ નુકસાન**  
જળકુંભીના ઈતિહાસમાં ડેડિયું કરીએ તો જળકુંભીએ ઈશ્વર અપેક્ષિતની એમોએન નદીની વાસસ્થિત છે. જેનું ભારતમાં આગમન મેન્ગાળાથી થયું છે. જળકુંભીના કારણે મેન્ગાળા સંસ્થાના માછલીનાં મોત થતાં ત્યાં જળકુંભીને ટેર સોલે બેન્ગાળ તરીકે ઓળખાય છે. જળકુંભી પાણીમાં અને જળાન પર એમ બે જગ્યાએ થાય છે. તેના બીજા 28 વર્ષ સુધી નાશ પામ્યા નથી. પાણીમાં બે મીટર સુધી ભિત્તિ પર જમાવી જળકુંભી 22 ટકા પાણી શોષી લે છે એટલું જ નહીં પણ સૂર્યકાશ પણ પાણી સુધી પહોંચવા દેતી નથી. જેના કારણે જળચર પ્રાણી માછલી, કમળા વગેરે મોટી સંખ્યામાં મોતને ભેડે છે. જળકુંભીની વિષધિત અસરને માન લઈ 2016ના વર્ષમાં કુટિલિય સ્કે જળકુંભીના વેપાર પર પ્રતિબંધ લાગતો બરડો પણ પસાર કર્યો છે.

## તાપીની દુર્દશા એકાદ નહીં, પણ વર્ષોની દેન છે છેલ્લાં 22 વર્ષથી તાપીમાં પાણી ઓછું ને ગંદકી વધારે ઠલવાય છે



**સુરત | તાપી મેયાની આજે જે દુરુણ અને કુદરૂણ હાલત છે તેની પાછળ એક-બે વર્ષની નહીં પણ સતત 22 વર્ષની કહાની જવાબદાર છે. કે તેમાં પાણીકું બની ગઈ હોય તેવી સ્થિતિ છે.**

**છલોછલ વહેતી નદી ખાબોચિયું બની ગઈ છે**

મમ્મપ્રદેશથી ઉદ્ભવી વાયા મહારાષ્ટ્ર થઈ ડુમસ નજીક દરિયામાં ભળી જતી 724 કિલોમીટર લાંબી તાપી નદી પર 1972ના વર્ષમાં ઉકાઈ રેમ બંધાયો. ત્યારથી પાણીનું વહેવું મર્યાદિત થઈ ગયું. ત્યાં સુધી તાપી છલોછલ વહેતી હતી. ત્યાર બાદ 1995 સુધી થોડી ધણી પણ સ્થિતિ સારી હતી. 1995 પછી તો હાલત ખૂબ જ ખરાબ થઈ ગઈ. કારણ કે 1995માં તાપી પર વીયર કમ કોઝ-વેનું બાંધકામ કરવામાં આવ્યું. કોઝ-વેનું બંધાયા બાદ તાપીમાં પાણી વહેવાની માત્રા ખૂબ જ ઘટી ગઈ. કદો કે, લગભગ બંધ જ થઈ ગઈ! પરિણામે હાલમાં તો કોઝ-વેથી લઈ છેક ડુમસ સુધી માત્ર અને માત્ર ગટરિયાં પાણી જ વહે છે. એટલે કે ગંદકી સિવાય કંઈ બચ્યું જ નથી.

વર્લ્ડ કપની ટુટાની જેમ લંકેડો રસ્તા પર ઊતરવા જોઈએ લવ રિવર-ફિલન રિવરના સુત્ર તમે જળકુંભી દૂર કરવાનું કામ કરી રહેલા 30 યુવાનોનું નેતૃત્વ સંભાળી રહેલા સાગર વસોયાએ કહ્યું હતું કે જે રીતે ભારત જ વર્લ્ડ કપ જીત્યો તે વખતે લોકો રસ્તા પર આવી ગયા હતા તે રીતે તાપી સુદ્ધિકરણ અભિયાન માટે પણ લોકો રસ્તા પર આવી જાય તો આ કામ સરળ બનતી જાય.



**30 યુવકો સ્વખર્ચે જળકુંભી કાઢે છે**

બે મહિના પૂર્વે આ તમામ યુવાને સાથે મળી લવ રિવર-ફિલન રિવરના સુત્ર સાથે મોટા વરાછામાં સેટેલાઈટ રોડ પર યમુનાચોક ખાતે તાપીમાંથી જળકુંભી દૂર કરવાનું કામ શરૂ કર્યું. તમામ સ્વખર્ચે એક મશીન બનાવ્યું જેમાં ખૂબ મોહનતાના અંતે જળકુંભી કાઢી શકવામાં આવે છે. સમયાંતરે આ યુવાનો પોતાના બેરોળમાંથી કેઈન બોટ મગાવીને પણ જળકુંભી દૂર કરે છે. જો આ યુવાનો સ્વખર્ચે આટલું કામ કરી શકતા હોય, તમામ યુવાનો રાજકારણી રાજકારણને એક બાજુ પર મૂકી તાપી મેયાની સેવામાં લાગી જાય, તમામ સેવાભારી સંસ્થાઓ સામાજિક પાર્શ્વિક સંસ્થા જો આ કામ પોતાનું છે તેમ માની કામે લાગે તો સ્થિતિ અલગ જ હોય.

## ૧૬ ગુજરાત સમાચાર (સુરત આવૃત્તિ)



અમરોલી તાપી નદીમાં વોટર વર્લ્ડની આજુબાજુમાં જળકુંભી સામ્રાજ્ય પુનઃ સ્થાપિત થઈ ગયું છે. હવે ક્રીડાના ભાગના આ માટે જોઈએ કિડ્સનો? (સપ્ટેમ્બર 2016)

Figure 31. Newspaper articles highlight water hyacinth issue.



## Acknowledgment

Author would like to extend his gratitude to Shri “Nainish Parekh” & “Nature Club Surat” for supporting this study. He is also grateful to Muni Raval for giving his valuable inputs and suggestions for this serious issue. At the end he is thankful to Surat Municipal Corporation, political parties, communication Media, & citizens of Surat for understanding this issue and playing vital role in finding solution.

## Useful resources related to water hyacinth.

**North Eastern Development Finance Corporation Limited.**

North Eastern Development Finance Corporation Limited.

"NEDFi House"

G. S. Road, Dispur, Guwahati

Assam. PIN - 781006

Ph : +91-361-222 2200

Fax : +91-361-223 7733 / 7734

Mail : [mail@nedfi.com](mailto:mail@nedfi.com)

**(Water Hyacinth Handicraft Manufacturing and supplier)**

### **Centre for Research on Aquatic resources**

Dr. G. Nagendra Prabhu,

Principal Investigator

P. G. Dept. of Zoology & Research Centre,

S. D. College, University of Kerala,

Alleppey -688003, Kerala, INDIA

Ph: +91-9495017901

Email: [nagendra.prabhu@gmail.com](mailto:nagendra.prabhu@gmail.com)

**(Conducting research of aquatic resources such as water hyacinth)**

### **Conifer handmades / Ravi Exports**

Ravi Exports,

Purvi Sandh (Propertier), No. 601, Brooklyn, Lokhandwala complex,

Andheri West, Mumbai - 400053

Maharashtra, India.



Mobile:

+91-9320363500

+91-9323331951

Telephone:

+91-22-26366095

**(Supplier of notebook made of water hyacinth)**

**Radhe Equipments India**

Gondal Road Circle, Behind Perfect True Value Showroom

Vavdi

Rajkot - 360004 Gujarat, India

Dhaval Dave

08048603336

[www.radhegroup Rajkot.com](http://www.radhegroup Rajkot.com)

**(Supplier of Briquetting Machine for sugarcane bagasse)**