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Understanding sustainable techniques for urban parks: A case study of Agara Park, Bengaluru

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ABSTRACT

Urban areas are said to be healthier when it blends more with nature. Green pockets thus gain strategic importance for their contribution to give quality life. Due to growth in urbanization, there is an immense strain on land and resources. This calls for a need to enhance the green cover. Thus, the study intended to explore the ways to make use of such spaces more efficiently. Also in a course of time, these spaces lose their value. When green zones are developed sustainably with regular maintenance, there is a possibility of keeping the space active in terms of the usability of land. A live case study was conducted at Agara Park, Bangalore. This study is a compilation of the multiple techniques from the different research papers, books, reports which suggest sustainable methods to develop a park. It documents different factors like enhancement of ecology, improving social lifestyle, managing natural resources, and maximizing dependency on renewable resources to beautify the park. The typical methodology was evolved to preserve and develop the parks.

Keywords : *Development, Preservation, Wetland, Resource, Conservation*

1. Introduction:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. People who are exposed to nature and have experiences in nature are more likely to act responsibly toward it. Urban green space is one of the ways to bridge the gap between people and nature.

1.1 Need of Urban Greens:

The positive impressions of zoning green spaces within the urban areas are depicted as following:

1.1.1 Environmental benefits:

Green zones contribute to the maintenance of the urban environment by purifying air, water, and soil. They mitigate climate extremes by acting as temperature buffers in summer and wind breakers in winters. It improves urban microclimate by controlling many factors, a few of which are heat, CO₂ levels, and noise. It conserves a diversity of urban resources.

1.1.2 Social benefits:

Green spaces play a major role to release stress and acquire stability over the mind. It supports an

individual to achieve physical fitness and various health issues were observed to get improved. It is the place that helps to stimulate the senses through color, sound, and smell. Such spaces foster active lifestyles by providing opportunities for a wide range of educational and recreational activities. It creates scope to have personal space as well as interactive zones. It also enhances cultural life by providing a venue for varied festivals and celebrations.

1.1.3 Economic benefits:

A significant saving can be seen in the air conditioning loads for the spaces of surrounding areas. The temperature difference of about 1°C can reduce the use of up to 20% of air conditioning. [1] The strength of the park also goes on to add to the overall value of the adjacent lands.

1.2 Standards and Guidelines:

The international minimum standard suggested by World Health Organization (WHO) is a minimum availability of 9 m² green open space per city dweller. [2]

In India, as per the UDPFI guidelines, 1996 Ministry of Urban Development, the proportion of

green areas to the total developed area should be between 12-14% in small towns, 18-20% in medium towns and large cities, 20-25% in metropolitan cities. [3] Later in 2014, guidelines were revised under URDPFI which stated developing open spaces with area of 1.0-1.2 ha in small town, 1.4-1.6 ha in medium town and 1.2-1.4 ha in large city, metropolitan, megapolis for every 1000 person.[4]

1.3 Concept- Sustainability of Parks:

Despite the knowledge about its importance and value, the spaces zoned for green areas tend to convert into dead space with time, one of the reasons being lack of maintenance due to financial issues. To reduce the external dependency and optimize such spaces, sustainable techniques can help resolve the problem. Contextually, it can be used for the potential to maintain self-workability efficiently. Green spaces here can be termed to be sustainable when it is environmentally, socially and economically beneficial.

The study aims to disseminate the strategies for sustainable parks. The study intends to understand the various techniques with practical working detail and a suitable paradigm.



Fig.1 Scenic View of Agara Lake, Bengaluru

2. Onsite case study: Agara Park, Bengaluru:

The total area developed by Bengaluru Urban Division and Karnataka Forest Department for the Agara Lake is 142 acres as shown in Fig.1. The main lake area is 61 acres with an average depth of 2.3 meters. There are 8.5 acres of space in the southern part of the lake allotted for a constructed wetland. [5] Agara Park was later developed near the lake which has an area of about 6 acres. As the spot is located in Sarjapura ring road between Koramangala and HSR Layout, serves more than 1000 resident families to experience Lake Ecosystem which approximately covers the spread of 8km diameter [6] as shown in Fig.2.

polluted due to rapid urbanization and had become a den for anti-social activities. With encroachment on to the lake and lack of fresh water turned it into a sewage pool. The northern edge is a bund road and the southern edge is bordered by the outer ring road which has a heavy movement of traffic. The western-edge has a sewage carrying drain that bypasses the lake. The lack of connected and meaningful public spaces, absence of facilities for visitors to stay during the annual fairs, loss of access, deterioration of the condition results in a compromised quality of community life. In 2004, the Bengaluru Development Authority (BDA), together with the Forest Department, restored the lake by increasing greenery via tree

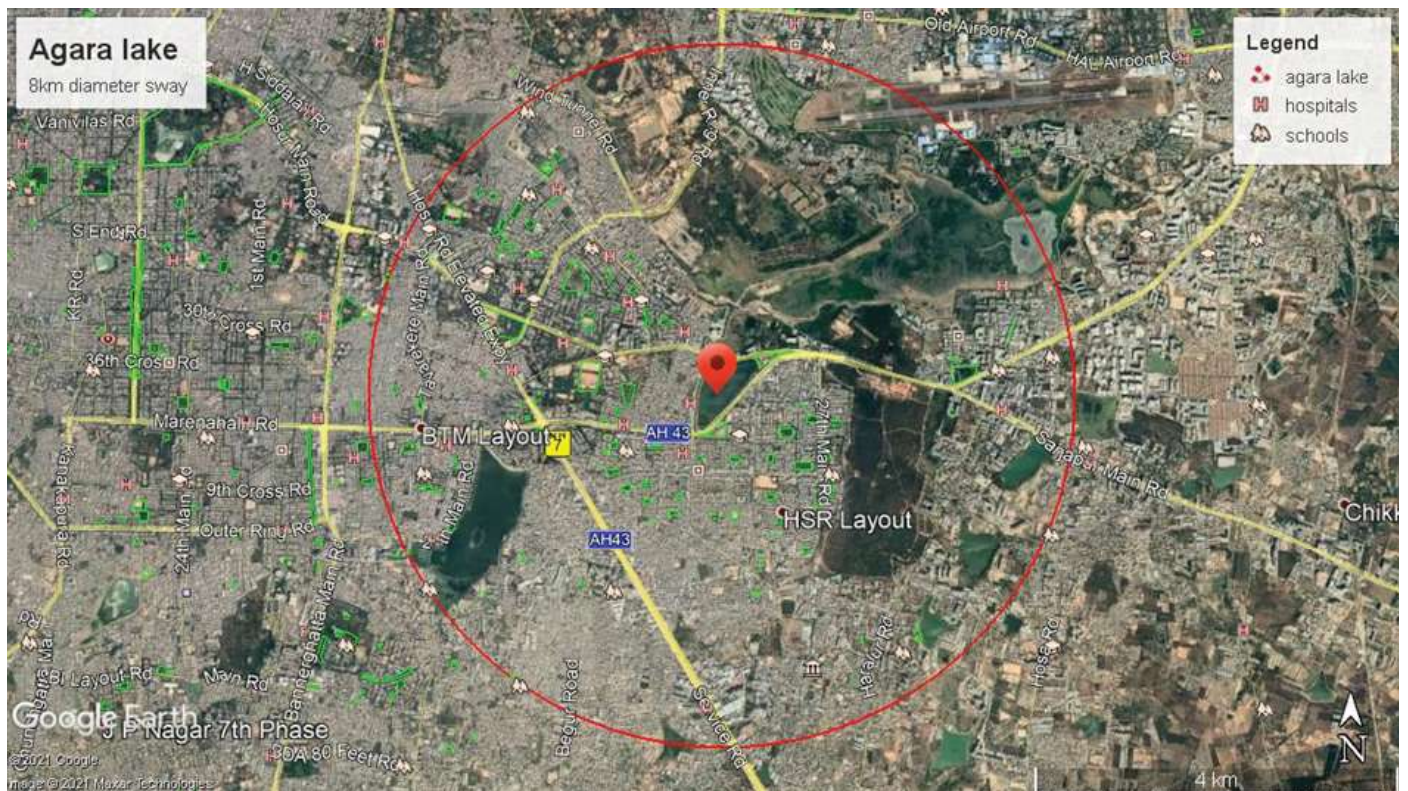


Fig.2 Agara Lake, Bengaluru - Google image

2.1 Background study:

Agara Lake believed to be constructed in the 8th century AD is one of the oldest lakes located in the southeast part of Bangalore near Sri Jagannath Temple in Agara Village where most of the celebrations, including the boat festival, were originally celebrated. It also catered to the irrigation and potable water needs of the resident of the surroundings. The lake got

plantation, developing joggers track, and protected with a fence around it. These attracted a large variety of birds and converted it into valuable lung space. But this didn't last long, due to litigation on Public Private Partnership (PPP) lease lack of basic maintenance, uncontrolled access, and lack of security resulted in heaps of debris dumped around, broken fence, reeking water, unkempt garden, tons of garbage, floating

plastic. In Feb 2012, the lake was handed back to Lake Development Authority (LDA). Then LDA and proactive Citizen Group ALPMS worked together to make revival a reality.

2.2 Design approach:

The environmental and social aspects served by the parks are accounted as follows:

2.2.1 Services:

Constructed wetland-A constructed wetland as shown in Fig.3 is an artificial wetland to treat municipal or industrial wastewater, sewage water, or stormwater. These wetlands are engineered systems that use natural functions like vegetation, soil, and other aquatic organisms to treat wastewater. They serve as a habitat for various organisms. Plants like cattail and reeds are known to absorb and retain phosphorous, nitrogen, and heavy metals in large amounts. Hold floodwaters for varying periods and can release them gradually. Thereby mitigate flood effects. Contribute to the recharged groundwater and acts as a natural trap for silt and organic matter. Helps in enriching floral and

faunal diversity and water treatment through wetlands will incur very low maintenance costs.

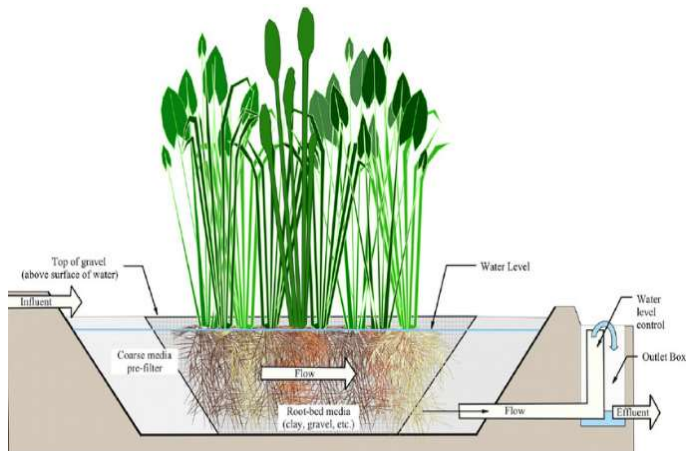


Fig.3 Constructed Wetland [7]

Floating emergent macrophyte treatment wetlands were implemented in Agara lake. The wetland region is divided into 5 zones separated by rock bunds as shown in Fig.4. The sewage from Naala 1 enters the 1st Zone of the wetland and the wastewater from Inlet 2, which is the storm drain flow, enters the 5th Zone of the wetland through the silt trap.



Fig.4 Agara lake, Bengaluru depicting services [5]

Floating Islands- Floating emergent macrophyte treatment wetlands as shown in Fig.5 are a hybridization of ponds and wetlands that offer potential advantages for the treatment of wastewater entering the lake. In this method, rooted, emergent macrophytes are grown on a mat or floating rafts, instead of rooting them in the soil underwater. The macrophytes used on the floating islands absorb the organic and inorganic compounds from the water, in the process of purifying it. Plants used in floating islands are vetiver, typha grasses, and some native flowering plant which were easy to harvest.

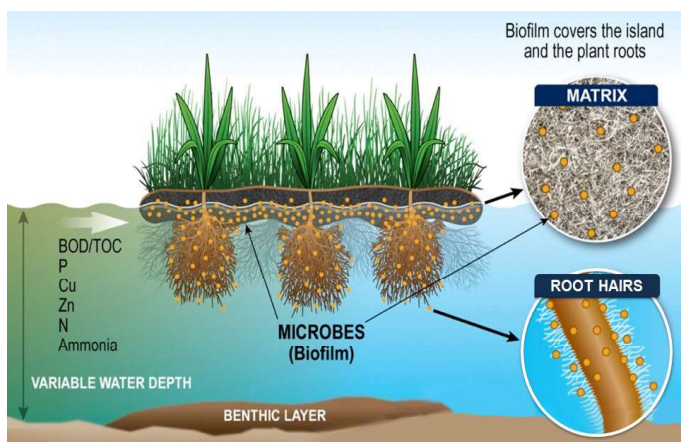


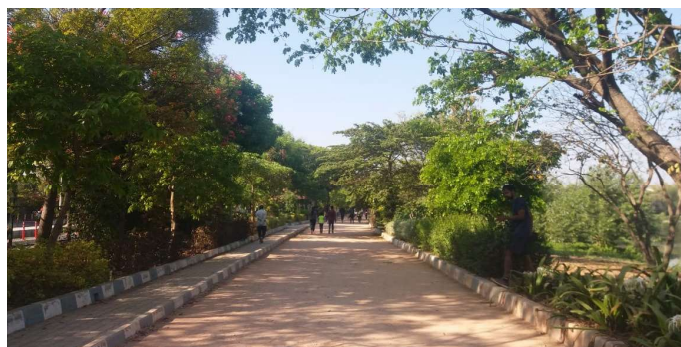
Fig.5 Functioning of floating island [8]

2.2.2 Facilities:

The social benefits were achieved through the amenities for citizens which were planned in a very natural way to ensure less impact on the flora and fauna. Few of the facilities provided in the park were enlisted-walkway and cycle path (Fig.6a), yoga platform, gazebo (Fig.6b), immersion tank, outdoor gym (Fig.6c), butterfly garden, children play area, restrooms, benches (Fig.6d), boat jetty with signage board as per requirement.

1) Idol immersion tank-Stepwell is being built on the north side of the lake in the children’s play area. It is used for observing several rituals and to ensure that the main lake is not polluted. The outlet of the tank is an inlet into the lake.

2) Outdoor gym and children’s play area-Playground and fitness systems primarily consist of two elements, steel components, and plastic components. All steel components are manufactured from the best steel, which is first sandblasted, flow coated, hot-dip galvanized, and finally, powder-coated for perfection. [9] It is built to withstand the test of time and is solid, stable, and rugged that can withstand climatic conditions. These systems are built without the need for any major regular maintenance.



a) Walk way and cycling track



b) Gazebo



c) Outdoor Gym



d) Sitting area

Fig.6 Agara lake, Bangalore a) Walk way, Cycling Track, b) Gazebo, c) Gym, d) Sitting area

2.3 Key features:

Sustainability achieved concerning environmental and social perspectives are:

- 1) Pollution filter- Plants absorb nutrients from heavy metals and allow silt to settle.
- 2) Flood control- Functions like a sponge, soaking up water. It can hold over 200 million liters of water in the monsoon.
- 3) Carbon sequestration- Help in sequestration of a considerable amount of carbon
- 4) Habitat- Breeding grounds for many birds and fishes. It also supports rich biodiversity.
- 5) Groundwater recharge- Surface water enters the underground aquifer, thereby recharging groundwater.
- 6) Recreation- Provides recreational activities like bird watching, photography, etc.

3. Approaches for Sustainable Park:

The description of various methods has been collated which has been proved to be a sustainable way to develop a park through different studies. The sources of information include various research papers, books, survey reports published in scholarly journals describing the same.

3.1 Preserving site inventory:

The natural and existing features should be considered as boon and avoid disturbances to reduce long-term environmental impacts.

3.1.1 Site and topography:

Sensitively reusing historic structures if present on the site and working to safeguard these resources from vandalism, development, or weathering. Local cultural features to be protected if present on site. Existing trees and water bodies should be protected to promote biodiversity. Natural topography which generally indicates rocks, terrains, etc. should be retained.

3.1.2 Soil Condition:

Fertile topsoil should be preserved as this is one of the ways to control soil erosion. Loamy and sandy soils

are considered to be ideal as more stormwater can be infiltrated followed by clay soils. Whereas compacted soils are not at all recommended. Soil compaction occurs when soil particles are pressed together. This reduces the space in the pores, where air and water can no more be trapped. This gets difficult for plants to grow and stormwater to infiltrate through the soil into groundwater.

3.2 Selection of plants:

The liveliness in any kind of space first comes with the plantation of trees. Increasing tree canopy gives a different dimension to space. The impervious areas should be shaded from tree cover to reduce the urban heat island effect and to upgrade the micro-climate. It really depends a lot for the park to survive on the selection of plants. Selected species should also be planted at the right time of the year.

3.2.1 Native species:

Native plants are preferred as they require less human intervention. This is because they are adaptive to the climatic conditions of the place and can reap the environmental benefits. They have easy growth depending upon the soil, moisture, and light conditions of the place, hence they require less additional nutrients. Not only native but the species should belong to the same ecoregion. Native plants may change with time due to climate change seen. The species with drought-tolerant characteristics should be encouraged in dry areas to minimize the water consumption of the landscape area. Carbon sequestration trees and plants have the capacity to retain carbon in their roots, stems, and leaves. These also remove pollutants like Sulphur dioxide and nitrogen from the air. The sustainable turf management system should be followed and should be chosen among the native warm-season grasses as they require less frequent maintenance.

3.2.2 Habitat attracting species:

Efforts should be taken to attract and retain other living species. Native fauna tends to live alongside native species of plants and use them as a source of food and shelter. Choosing plants becomes important as to

know the type of fruit and flowers that will be preferred by the creature going to live there or by the birds which will visit there. It helps to enhance biodiversity. At the same time, some plant species should be such which repel mosquitoes and other insects to ensure health and comfort for the visitors. The growth of algae and invasive plants should also be controlled as they tend to harm native plants and animals.

3.2.3 Revenue generating species:

Trees can also be a good source of financial support to help the expenses of a park through its products, mainly fruits, and flowers. Medicinal plants are recommendable. Bamboo can be widely used as it is a highly nutritious plant that can be used by both humans and livestock. Its strong fibers can be used as building material or varieties of products can be made out of it. Set up of own nursery and plantation of saplings can be made possible within the site area. Organic and local food production of fruits and vegetables should be promoted to encourage food self-sufficiency as urbanization may lead to the conversion of agricultural land.

3.3 Maintenance:

The methods carried to sustain the park should not have any adverse impact or pollute the environment. They green techniques must be promoted.

3.3.1 Natural fertilizers:

Using compost and natural products for mulch and fertilizer will help enhance the soil and feed plants. Good quality soil will then reduce the need for fertilizers and supplemental watering. The grass clippings of the lawn should be leftover as the natural source of fertilizer and moisture retention. Synthetic fertilizers can be used on turf areas and herbicides for weeds. Overuse of fertilizers can also burn out the trees.

3.3.2 IPM practices:

Integrated Pest Management is an ecologically-based approach to pest control that helps maintain strong and healthy plants. It can include the use of traps, sterile male pests, quarantines. It minimizes the use of chemical

pesticides. Pesticides applied should be specifically formulated. The environmentally preferable product includes ingredients that are certified to contain a lower or insignificant amount of toxic or hazardous material and have a low adverse impact on the environment.

3.3.3 Energy-efficient system:

Fuel-efficient machinery to help recharge ground water, reduce erosion and run-off rate. Avoid using gasoline and diesel-powered lawn equipment as they may contribute to air pollution. Non-emergency lightings used at pathways, landscaping focus lights should have timer controls and motion sensors. Noise from mowers can disturb nesting habitat so care must be taken. Application of efficient pumps and motors.

3.4 Diversity of users:

Spaces shall be responsive to the potential users and environment. Parks must facilitate and encourage use, be a place that people enjoy being in, and that they willingly like to visit again

3.4.1 Age, gender, race:

Ideal parks satisfy the needs and give way into the people of all the age, gender, race. Safety measures should be on priority so that the kids and females feel safe and free to visit the park at any period of time. Facilities and provisions should be user-friendly for the specially-abled group. This mainly includes suitable access to the entrance of the park, uniformity in flooring level wherever possible for free movement, non-slippery ramps with handrails and many more facilities to be given which will reduce hindrance in their activities.

3.4.2 Job opportunities:

Entering a public-private partnership that promotes sustainable practices could be a major step to maintain the space due to the active involvement of users. The contract can be given to maintain the park.

3.5 Amenities:

These elements acts as a focal point to attract people. Thus these must be recreational as well as educational set up for the upgradation of better social life.

3.5.1 Engrossing activities:

The basic amenities like drinking water facilities, restrooms, seating areas, cafeteria, and first-aid facilities should be provided. There should be a zone that also provides an opportunity for physical and healthy activities. Pathways for walking, jogging tracks, and cycling. Play area for outdoor games should be promoted. Design plays a large part in whether a space feels private, communal, or public. It is important to provide different activity zones with both active and passive uses. Gathering spaces to be developed to improve social interaction in society. It can be in the form of a clubhouse, amphitheater, or something else depending on the size and requirement of the neighborhood. The band stage, performance stage should be built so small events can be conducted. Bird watching, sun gazing zones. Silent zones like spiritual or meditation spaces, which are meant to de-stress or relaxation should be designed to give cognitive experience to users. It should be well lit and all the signage marked rightly.

3.5.2 Educational opportunities:

Educational setup can be offered through kiosks, displays, bulletin boards. Adult classes, youth workforce training can also be conducted if such spaces are designed. The public can also be engaged in environmental practices like promoting community garden opportunities and many more. Conducting public education and offering recycling stations. Decentralized collection of wastes of users into suitable bins like paper, plastic, food to be segregated at the source itself. Smaller steps of sensitivity towards nature since childhood can make their habit, leading to a better future. Multiple signage can be installed to direct the ethics expected from people in the park like not to litter, spit, smoke, etc. Showcasing the importance and benefits of the landscape can also influence their behavior. Provide education on sustainability and awareness measures to be taken for on-site sustainability features applied to their environmental-friendly behavior.

3.5.3 Material Palate:

The use of salvaged materials and products should be encouraged to reduce the demand for virgin materials. Use of recycled materials and debris to be used as it has

low embodied energy and low carbon footprint. This will again minimize the impacts related to extraction and processing involved. The use of locally available materials can minimize the environmental impacts. Chemically treated wood for picnic tables and decks. Perches and lounge chairs. Using low-flow fixtures at both water stations and toilets. Landscape overbuilt structures can be encouraged. Use of materials with low emissions to reduce adverse health impacts, mainly paints, coatings, and adhesives with low VOC contents. To blend with the surrounding, natural materials like stone and wood can be used. Temporary structures can be promoted by using tensile technique or steel, as it makes it easy and flexible to modify after a certain period of time.

3.6 Water conservation:

Groundwater tables should be enhanced to reduce municipal water demand through various means. On-site rainwater treatment and filtration techniques can be incorporated in the design to remove contaminants and total suspended solids.

3.6.1 Irrigation system:

Efforts to be taken to reduce water demands through efficient systems. Soaker hoses can be used instead of sprinklers. Central shut-off valves to be fixed. A time-based controller can be used for the valves such that the evaporation loss is minimum, and plant health is ensured. Pressure-regulating devices help to maintain optimal pressure to prevent water loss. Few more features like moisture sensor controllers, water leak detection systems can be installed. To conserve potable water, harvested rainwater or treated wastewater can be reused if possible.

3.6.2 Ground cover:

Efforts should be taken to minimize hard and non-porous surface area. This could be accomplished by narrowing roads and use of mulch, gravel, porous pavements, and vegetation. But even when turf mowed low to ground level may have a higher runoff rate. Precipitation flows quickly over non-porous material carrying soil, nutrients, pollutants, and weed seeds with it. Even porous athletic surfaces can be made like

basketball and tennis courts. These surfaces allow water to trickle through the material. Such surfaces are beneficial as water accumulation is not there, increase in lifespan of the product, and no stormwater management is required. Fragmentation of land should be avoided.

3.6.3 Stormwater:

Stormwater may be captured and managed in various natural ways. A swale is a gently sloped vegetated ditch where pollutants are removed from stormwater by filtration through native grasses and other plants. It is an economical alternative to underground stormwater pipes and holding tanks. A rain garden is a shallow depression in the ground filled with sandy soil and planted with deep-rooted native vegetation. It is generally created from where it is easy to catch the water run off from hard surfaces. This helps to slow down the speed and can hold the water so it can naturally infiltrate into the ground. These techniques provide habitat especially for birds and butterflies, create an aesthetically appealing site with decreased need for irrigation. Stormwater can be collected, stored, cleaned, and can be reused in fountains, etc.

3.6.4 Wetland and Riparian buffer:

Wetlands crucially function for the better health of the aquatic and terrestrial ecosystem. It majorly helps to recharge groundwater. This has the ability to trap sediments, fertilizers, and pollutants before they enter the water cycle. Seasonal pools are shallow so possibly they may not satisfy aquatic habitat. But ponds and birdbaths may add to their necessity for dependence on water. Wetlands are generally protected by a riparian buffer. These are the areas with vegetation around the water bodies. They slow down the runoff from precipitation and help to recharge the groundwater. They prevent soil erosion and sedimentation of the water body. These buffers provide leaves and woody debris as food. They trap the pollutants within plant roots and also acts as temperature control for water body adding habitat value for aquatic organisms. Because when the

temperature increases, dissolved oxygen levels are reduced leading to an increase in mortality of aquatic life. Otherwise, it is more likely for algae and other nuisance plants to grow and create disturbances.

3.7 Maximize renewable resources:

These techniques avoid the net emission of greenhouse gases such as carbon dioxide and methane into the atmosphere. It also prevents depletion of fossil fuel resources which further helps in minimizing carbon footprint.

3.7.1 Solar:

Solar energy harnesses sunlight to produce energy in the form of heating, cooling, or electricity. Energy can be produced on-site to fulfill the required demand through photovoltaic technology by installations of solar cells, units, photovoltaic sun fields, and the use of solar collectors. The solar panels could be either mounted on walls, roofs or can be used to provide shelter.

3.7.2 Bioenergy:

Renewable energy is made available from materials derived from biological sources. Biogas is produced when bio-degradable organic materials/wastes are subjected to a scientific process, called Anaerobic Digestion. Raw material like gardens, plant material, green waste, or kitchen waste can be fed in biogas plants to get an improved organic manure system based on bio-slurry. It can also provide clean cooking fuel or used to meet thermal and power needs. Recycling centers should be set to convert the waste of plants into fertilizers. This will reduce landfill waste and save intensive transportation of waste to landfills. Composting can be practiced [10-17].

4. Discussion:

Parks with active spaces will create stronger and safer neighborhood units. The perspective of planning and developing parks decides the future scenario of the place. It remains lively when invested with a long-term approach. The methodology was derived through the combination of strategies which gives a structured approach to outreach the goal. The flow chart for sustainable park development is as shown in Fig.7

Methodology - Sustainable Park

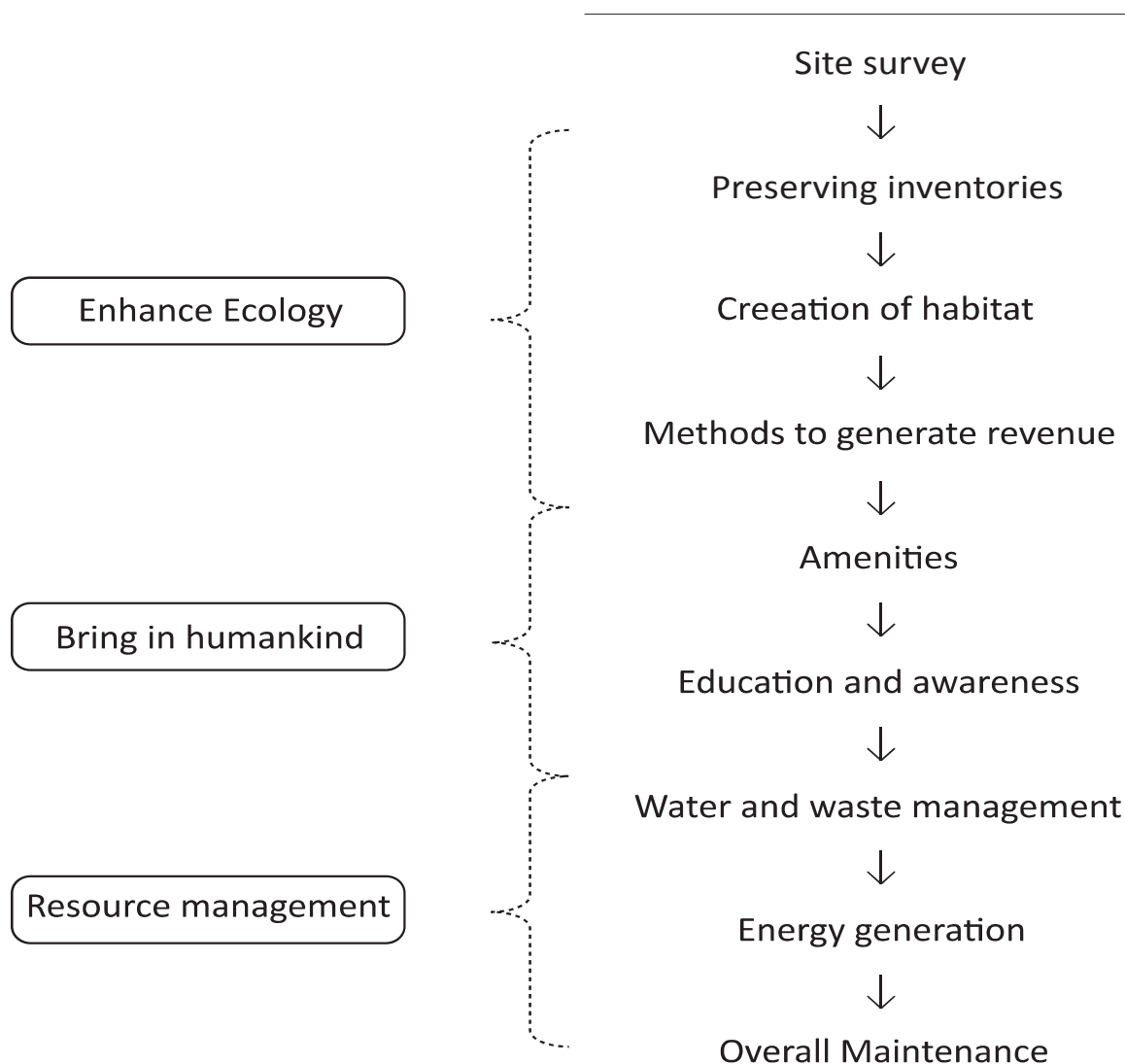


Fig.7 Procedure derived to achieve a sustainable park.

A park can be multifunctional, but not necessarily these multiple uses can be achieved everywhere. The techniques upgrades with time and more innovative ideas can evolve, so the methods of sustainability will also change.

5. Conclusion:

From this research the key aspects for a better planning of sustainable parks could be inferred as:

5.1 Environmental aspect:

1) Efficient utility- The core value of the resources available on the site area should be identified and avail the benefits as they also help to combat and reduce

some of the potential negative impacts of climate change. Human interventions should be minimal.

2) Self-reliant- It may need some time for the park to establish the green cover before they are fully usable. But the dependency for long term can become the hindrance for the future survival.

5.2 Social aspect:

1) Public participation- Surveys should be carried out to know about the culture and interest of the users which will add on the characteristics to that particular park to make it unique. Sensitivity towards the environment and volunteer involvement of citizens is the most essential part of this journey.

2) Collaborative relationship - Inclusive involvement and co-operation among the citizens, government and stakeholders is required. Feedback from the visitors needs to be taken at intervals to enhance user experience and initiate a corrective action plan. This creates an opportunity for continuous improvement. Concurrently, citizens should be aware of their responsibilities and behavioral pattern in the park.

5.3 Economical aspect:

1) Economic viability- Park remains lively when invested with a long-term approach. Performance tracking of the overall functionality of the park to be maintained to understand the level of effectivity achieved through the adopted methods.

2) Regular maintenance- The biggest challenge is not to ensure the greening of the urban area but to maintain and sustain the green cover. The development should be planned and executed in such a way that their operating system requires less maintenance cost.

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