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Bio-Mining; A Catalyst in Sustainable Green Development

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Abstract: ***The high degree of industrialization and the changing life style of the people all over the world have made multiple effects on the creation of solid waste and that led to an ecological imbalance to a larger extent. The unscientific form of developments and lack of proper waste management measures leads to many kinds of ecological issues. The enormous volume of waste in degradable and non - degradable form including plastic and electronic waste is an unsolved problem in the digital age. The problem of waste management is more critical in urban cities than in rural areas. Solid Waste Management is a serious issue prevailing in most of the urban cities in India. An Indian state named Kerala also experienced the same. The waste management facilities in Kerala are inadequate when compared to the quantity of waste generated in the region The bio - mining project initiated in Kerala in a place named Kureepuzha in Kollam Corporation where the waste yard is located had gained the attention of many in recent times. Bio mining is a scientific process of excavation and gainful utilization of the materials recovered from the accumulated waste. The bio mining project at Kureepuzha was very successful that too implemented at the local level without creating any environmental damages. The bio mining offers a remedy to the unresolved problem of solid waste management in all the developing economies.***

Keywords: Bio mining, E - waste, Urbanization, Landfill, Excavation.

1. Introduction

The development activities of the so called civilized society sometimes exert high pressure on the nature and eventually lead to many kinds of ecological imbalances. The extreme exploitation of the nature sometimes unleashes severe threat to the entire living organisms on earth. In the modern development era, pollution of various forms are turning in to an acute state and the accumulation of massive volume of waste is a common issue faced by most of the countries. Lack of sufficient waste management measures stand as an unsolved problem of the 21st century. The high degree of industrialization and the changing life style of the people all over the world have made multiple effects on waste creation and ultimately leading to environmental damage. Population explosion, high priority for urbanization, destruction of the natural vegetation, unscientific way of construction activities and the ineffective implementation of waste processing facilities all adversely affect the ecological balance of the nature. The increased use of electronic and digital gadgets in the digital era is accelerating the accumulation of e - waste in the country. The enormous volume of e - waste in non - degradable form is a serious threat to the eco system. Plastic as an unavoidable new normal necessity and the excessive use of it promotes the accumulation of large quantity of plastic waste in rural and urban areas of the country. Burning of plastic and other waste components produces harmful emissions and highly contaminating the quality of air. Waste management seems to be an enigma in many ways and the planners and administrators were confused to find a total solution to the same.

Like other developed countries India too faces the problem of Solid Waste Management [SWM] as a challenging issue. Increased industrialization and the migration of people towards cities in search of job leads to high density of population in the urban cities and intensifies the creation of huge volume of solid waste in urban areas. The excessive volume of waste creation is dangerous as it leads to many complex issues like air pollution, water pollution and many health disorders. The setting up of many industrial and housing apartments without adequate waste processing facilities leads to the creation of huge heap of solid waste in urban cities. Waste water disposal and drainage facilities in many urbanized regions are below the requirement. Recycling or proper treatment of waste in time is a necessity to sanitize the regions. The problems associated with waste dumping in open landfills leads to water contamination, spreading of infectious diseases, air pollution etc.

Many people of developing countries follow the system of open landfills to do with waste management. Waste management in India is getting a slow momentum [Sajith P, S 2015]. Open landfill is an unscientific way of waste handling and can cause many heath issues like water contamination, spreading of infectious diseases, bad odour etc. There is an enormous increase in the quantity of medical and pharmaceutical waste during the Covid - 19 period (World Health Organization). Waste landfill is an unscientific passive approach that leads to the accumulation of mountains of waste and it is still an unsolved issue in many urban cities of Kerala. Highly populated municipalities of Kerala are lacking properly managed solid waste management system [Sajith, P, S.2015]. Many landfill areas are covered with exorbitant volume of debris, used plastic items, e - waste etc. The main reason for increasing the Municipal Solid Waste [MSW] is the urbanization and industrialization of the cities. The issues associated with waste creation, inadequate waste collection, insufficient transportation facilities, unscientific way of waste treatment and disposal is apparent in India [Sunil Kumar *et al*.2017]. Environmental statistics says that there is an enormous increase in the volume of waste generated in urban areas. Rapid industrialization and population explosion in India has forced people towards urban migration and that led to the accumulation of Municipal Solid Waste to a large extent

(Brilliant Rajan *et al* 2015). Public apathy and improper technology are the other factors that leads to ineffective waste management [Athira Ravi., Subha 2013]. The total quantity of solid waste generated in Kerala is about 11449 tonnes per day. The local authorities were able to process nearly 75 per cent of the same and there exist a gap of almost 25 per cent in processing laxity. [Kerala Haritha Kerala Mission Survey]. Out of the 1192 million liters per day of sewage water generated, there exists a gap of 7 million liters for treatment. The waste management measures at present are not capable enough to manage with the volume of waste generated in the country. The increasing urban population leads to harmful impact on the environment and public health. [Sunil Kumar *et al*.]. The dumping of solid waste is a serious ecological issue in Kerala and that leads to many threats like low sanitation, air pollution, water pollution, and environmental degradation [P S Sajith 2015]. Institutional deficiencies also exist in effectively implementing the waste management practices in the country. Effective measures for regular and timely waste collection and disposal is an indicator of efficiency of the administrative authorities of a region.

Objectives of the Study

1) To understand the various reasons of waste generation in rural and urban areas.
2) To study the possibility of bio - mining strategy to clear the open landfill areas.
3) To suggest better measures to improve the waste management practices in the country.

Statement of the Problem

Solid Waste Management is a serious issue prevailing in most urban cities in India. In many regions of Kerala also waste accumulation is remaining as an unsolved problem especially in the urban cities of the state. The bio - mining project initiated by Kollam Corporation in Kerala state in clearing the waste yard at Kureeppuzha region had gained the attention of many including the World Bank team. The bio mining done at Kureepuzha was successful in finding solution to an unsolved problem that existed in the region for many years. Since Kureepuzha is located in a Ramser site in Kerala, the bio mining project implemented in the region is rated as a successful one. Many studies are available on the topic of waste management and green measures in various contexts. But studies focusing on a successful bio mining project are found very rare. Sufficient research gap is identified in this area of study. Hence the study feels worthwhile in excavating the scope and methodologies of bio - mining project completed in Kureepuzha region.

Significance of the Study

The Kureepuzha region had long suffered as an unofficial dumping ground, leading to an accumulation of waste that caused severe environmental and social problems. Over time, the gravity of the situation prompted widespread protests from local residents and households. Responding to this public outcry, the Kollam Corporation took a proactive step by initiating waste disposal through bio - mining. This innovative approach involved the excavation and processing of the accumulated waste using environmentally sustainable methods, transforming a longstanding problem into an opportunity for resource recovery and land restoration.

The significance of this case extends far beyond Kureepuzha. Waste management is a persistent challenge for many urban centers in India and around the world. Bio - mining offers a sustainable and economical solution for clearing old landfill sites, recovering usable resources, and reducing environmental pollution. By applying bio - mining techniques, urban areas can reclaim valuable land, mitigate health hazards, and reduce their ecological footprint.

This study not only highlights the success of bio - mining in the Kureepuzha region but also provides practical insights into its broader applicability. It suggests that bio - mining could become a key strategy for addressing the pressing issue of solid waste management faced by many cities. The lessons from Kureepuzha emphasize that with the right policies, technologies, and community involvement, even long - neglected waste heaps can be transformed into valuable assets for sustainable urban development.

2. Methodology

The study is descriptive in nature. The study concentrates on the bio mining project that successfully implemented in Kureepuzha region, a Ramser site in Kollam District of Kerala state which is located on the southern part of India. Only secondary data is used for the study. In this connection references were made out of various publications including journals, newspaper reports, website etc. The study made use a systematic presentation of the bio mining process and its successful implementation in Kureepuzha region. The details of the study announce certain theoretical inferences on the bio mining process done in the clearing of legacy waste at the dumping yard.

Bio - Mining; A Remedy to Solid Waste Management

Kerala is a small state in the south western border of Indian peninsula and is enjoying a unique geographical location. The biodiversity of the state is significant in deciding a moderate climate in the state. The state is gifted with a long coastal belt, many rivers with abundant aquatic resources, forests with wildlife and beautiful natural vegetation. Kollam is one among the 14 districts of Kerala and is located on the southern part of Kerala state. Kollam city is located on the banks of Ashtamudi Lake and is having a population of 349033 with a density of 5400 persons per square kilometer (2011 census). Kureeppuza is a small region located near the district headquarters of Kollam and is on the shore of the Ashtamudi lake. Ashtamudi lake is declared as a Ramser wetland site as per the International Environmental Treaty 1971 (UNESCO) for conservation of sustainable habitats. The place is surrounded with water bodies and is situated in an ecologically sensitive location.

The residents of the Kollam city generated about 64 metric tonnes of waste per day. (Amal Azad Zahib 2015). Most of the municipalities in Kerala produce large quantity of waste per day and is lacking proper and timely waste processing facilities. The Kollam Municipal Corporation was following a system of waste collection with open dumping of solid waste in a place named Kureepuzha. This is an ecologically sensitive area located almost 5 Kms away from Kollam city. For many years Kureepuzha has been used as a dumping yard of waste and a large heap of legacy waste was

accumulated in the area covering about 15.8 acres of land. This waste dumping yard is located in a low laying area with ecological significance. In this connection the inhabitants near Kureepuzha region met with many problems like air pollution, water contamination and spreading of infectious diseases. The people of Kureepuzha raised many protest against this serious ecological issue in their region and this matter has been noticed by The National Green Tribunal (NGT). Understanding the severity of the issue, the NGT issued an order to the authorities of Kollam corporation to scientifically process the legacy waste and clear the area with immediate effect.

The Kollam Corporation authorities decided to adopt a scheme of bio - mining reclamation project in Kureepuzha to resolve the solid waste accumulated in the region over three decades. Bio mining is a scientific process of excavation, segregation, treatment and gainful utilization of accumulated waste. It is the process of excavating waste from active or closed landfills to reduce the impact on environment. It includes the process of removing the dangerous materials and treating the same to segregate the combustible materials, recyclable materials and separating soil from it. The bio - mining project initiated in Kureeppuzha is the first integrated landfill mining project in Kerala which gained the attention of the World Bank and Niti Ayog. This project is implemented with the support of the World Bank.

Before starting excavation a drone based survey was conducted in the region to assess the quantity of waste dumped in the dumping yard. In order to evaluate the progress of the project, a district level monitoring committee was constituted under the chairmanship of the District Collector, Kollam. The area was filled with 1.04 lakh cubic meters of legacy waste heaped like a mountain and the site was cleared through the scientific process of bio - mining. As a first step towards waste clearance, about 8 acres of vegetative growth over the legacy waste at the dumping site was cleared and the debris was separated with the help of machineries. The hard materials and particles available in the area were separated in an eco friendly manner. The Refuse Derived Fuel (RDF) was handed over to cement companies in Tamil Nadu for use in furnace fuel. The combustible components available in the RDF are separated and are given to cement manufacturing companies for use as fuel instead of coal and firewood. Wind rowing was done with the help excavators to separate hard materials like bottles, wooden pieces, plastic items, rubber, tyres, slippers, chappels, hospital waste and solid particles etc. The separated waste was taken away by cement manufacturers and road construction companies for their use. Daily 500 to 1000 metric tonnes of waste was removed from this area. Precautions were also taken to avoid the emission of dangerous gases and to avoid the possible explosion during bio - waste separation. The bio mining process were able to separate soil into many varieties like fine soil, coarse soil etc. and is sold to the needy people for land filling in other regions. The foot wares separated with the help of Harden Shredder Machine is again sorted by manual labour in to three categories such as usable form, sole replaceable form and recyclable items. Comparatively very less quantity of electronic waste was excavated from the region. The clearing process was done by observing the instructions of the National Green Tribunal (NGT).

3. Findings and Suggestions

Bio mining is a scientific method of clearing the legacy waste and is a solution to the waste dumping issue in many regions. The quality of Ashtamudi lake water was improved to a great extent after clearing the waste from the Kureepuzha Ramser region. The growth of fish in the fresh water improved significantly after the cleaning process. There is a notable change in the quality of the air and water in the surroundings of the waste dump yard. The people who suffered from respiratory and other health issues were relieved to a great extent after successfully clearing the legacy waste from the region.

Developing a master plan for the separation of waste components into various categories from the source of origin is the first thing required to implement proper waste management. The separated materials is to be collected timely to take it for reuse, recycling etc. is the best remedy to reduce the accumulation of large heap of mixed waste landfills. The segregation and the processing of the bio degradable waste in the source of origin either by setting biogas plant or burying in the soil is the best remedy for dealing with bio - degradable waste. Revamping of institutional arrangements and enhancing the people awareness programmes and their role in effectively implementing the waste disposal measures is to be given higher priority. Long range future oriented master plans in alliance with the use of modern technology may support the waste management initiatives of a country. Attention should be given for the construction and maintenance of proper sewage and waste water disposal plants at the local level. Proper separation, value extraction and recycling in scientific manner are reasonable solutions for effective waste management. Construction of waste disposal plants, strengthening the legal and institutional set up, imposing fines and penalties for violators, social orientation and public participation are required for effective implementation of waste management programmes. Proper awareness programmes along with community involvement is the best remedy to address the waste disposal at grass root level. It should be the basic duty of every person or institution who is responsible for producing the waste in any form. Policy measures should be insisted with strict compliance of waste disposal facilities while issuing license to industrial units, slaughter houses, shopping complexes, hotels and even for dwelling apartments.

4. Conclusion

Waste management is a severe problem exposed to the civilized society and is a threat to the eco system too. The long years of legacy waste accumulated in Kureepuzha region were removed through bio mining process. The story of Kureepuzha is a successful one that too implemented at the local level without any environmental damages. It is not the sole responsibility of any government authority or agency to find solution to the waste disposal measures in the country. It is a collective responsibility of each and every citizen and implementation of proper policy governance

with stakeholders active involvement are required to implement any scheme successfully.

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