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Biomass for Energy Production and Interval Transportation Problem to Minimize Transportation Cost

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ABSTRACT : *India had all potential to meet out the necessity of an individual citizen. But due to the larger consumption of fossil fuels, India is in a crunch and scarcity in generating all sort of energy to fulfill the demand of the individuals. Government is taking innumerable campaign to yield energy through various renewable sources. Serious support of researches in the field of "renewable" energy resources like solar photovoltaic technologies (PV), biomass, wind turbine, geothermal will lead to new applicable energy. The high consumption of the individual, the growing population and the shortage of fossil fuels urged India in frantic pressure to accomplish the task. This paper focuses its attention on making use of renewable sources as an alternative source of energy in the energy crisis of India. Nagapattinam, a south coastal region of Tamilnadu in India has chosen for the study and a generalized findings and suggestions have been given based on the secondary data observed. A mathematical model to reduce the transportation cost is also given.*

Keywords: *renewable energy, municipal solid waste, biomass, bio fuels, biogas, fish waste, transportation problem.*

I. INTRODUCTION

India had all potential to meet out the necessity of an individual citizen. But due to the larger consumption of fossil fuels, India is in a crunch and scarcity in generating all sort of energy to fulfill the demand of the individuals. Government is taking innumerable campaign to yield energy through various renewable sources. In recent years the energy market is unstable, the energy shortage in India and high price of oil and natural gas made economical growth slow. Certainly there are challenges in developing renewable generation technologies, such as reducing the capital costs and improving energy efficiencies of the various types of renewable resources, such as wind, solar PV, solar thermal, and wave. Optimization techniques are used widely for solving real world problems including those arise from energy sectors.

Renewable energy sources for electricity generation are numerous. Sun, wind, flowing water in streams, flowing water in tidal channels, wave action in oceans, the earth's natural heat, biological materials, and others comprise the current portfolio of renewable energy sources, and additional renewable sources may be identified in the future. India discusses about future energy supply and use. A key question is how renewable energy resources might be used to meet India's energy needs, and to meet country's electricity needs specifically and economically. Renewable energy sources are typically used for three general types of applications: electricity generation, biofuels/bioproducts, and heating/cooling. The purpose of this study is to analyze the prospects, opportunities, and challenges for renewable energy sources to increase their contribution to the electric power sector.

II. BIOMASS

Biomass is waste of an organic outcome used to fabricate alternative renewable energy for the individual consumption. The biomass power can be generated from the agri - residues and waste from agriculture crops, forestry and related industries, such as rice, mustard and soya bean husks, straw, cotton and maize stalks, coconut and ground nut shells, wood chips, poultry litter, and bagasse. Other Crop debris such as stalks, straws, cobs, husks, oil cakes, shells, pods etc, Livestock wastes such as cattle, pig, poultry and sheep waste etc, Abattoir wastes such as flesh, bones, organs, blood etc, such as Bulk forest wastes such as wood, stubbles and Humus, Alternative forest wastes such as leaf litters, dead seeds and spores etc and Microbial biomass such as algae and bacteria from cultured systems can also be used for generating power.

BIOFUELS AND BIOMASS: Bio fuels are produced from biomass. Bio fuels are liquid fuels produced from plant materials, which makes them a renewable commodity. Biomass includes living organisms such as plants,

trees and crops, as well as half of all trash. The major potential of biomass is for production of liquid transportation fuels. These fuels include ethanol and methanol, two alcohol fuels made from corn, wheat and other crops, and methane, a colorless, odorless and flammable gas made from waste. In Europe, a total of 26.9 TWh of electricity was generated in 2010 from solid, liquid and gaseous biomass including landfill and sewage gas and biogenic waste the figure came to 33.3 TWh. There are millions of vehicles in the India, and these vehicles are responsible for two-thirds of the nation's total oil consumption. The quantity of biomass currently available could produce enough liquid transportation fuel to replace all the gasoline we currently use in these vehicles. By the end of the decade, technological advancements will make these fuels as affordable and easy to use as today's petroleum-based gasoline and diesel fuels.The biogas generally composes of 55-65% methane, 35-45% carbon dioxide, 0-3% nitrogen, 0-1% hydrogen, and 0-1% hydrogen sulfide [1]. Production of biogas from organic fraction of municipal solid wastes, different animal manures, fish waste, agricultural waste etc. were reported by different researchers.

BIOMASS IN TAMILNADU: According to Tamil Nadu Energy Development Agency, There are 17 biomass power plants in the state, each with a capacity of 7-10MW. Nearly 130MW is contributed by independent biomass generators.

The state has potential to generate 450MW of biomass power. But due to some problems it is difficult for the state to produce biomass power. Some of the reasons like lack of involvement among potential investors and the deficiency in settlement of payment to the farmers who are offering agri-waste biomass feedstock such as coconut stems and corn stalks.

Orient Green Power Company Limited (OGPL) is a leading independent renewable energy-based power generation company in India has 10 MW Biomass power plants near Pollachi. So the potential investors and entrepreneurs have to take an effort of producing energy through biomass which leads to benefit to the nation in supporting of generation of electricity and to create employment opportunities to our competent citizens.

III. SOLID WASTE MANAGEMENT

FOOD WASTE TO BIOMASS: The growing population and increasing consumer demand is leading to excessive consumption of available resources and generation of tremendous amount of different kind of wastes. It will be little difficult for us to prevent the wastages of foods in various places such as hotels, marriage halls and at home. But, at the same time all the wastages will come to a place, as garbage. It is a suggestion that the government can tender and provide subsidies to the potential entrepreneur to use the garbage hills for converting it into energy through small biomass plant in all the towns which will convert the Indian waste to energy industry.

BIOMASS FROM FISH WASTE: Nagapattinam district is an eastern coastal region of Tamilnadu. Major part of the population depends on fishing and its by-products. Fishing and agriculture is the major source of income of the people. Every day tones and tones of sea foods are collected from the sea, not only for the local consumption but also for the export. The fishes which are caught in Nagapattinam district is exported to various part of the world. In every value addition stage of improving the quality of sea foods, leads to a lot of wastage. In the boat house, at least a ton of sea foods can be seen as wastage every day due to the improper in size, poor quality and perished reason.

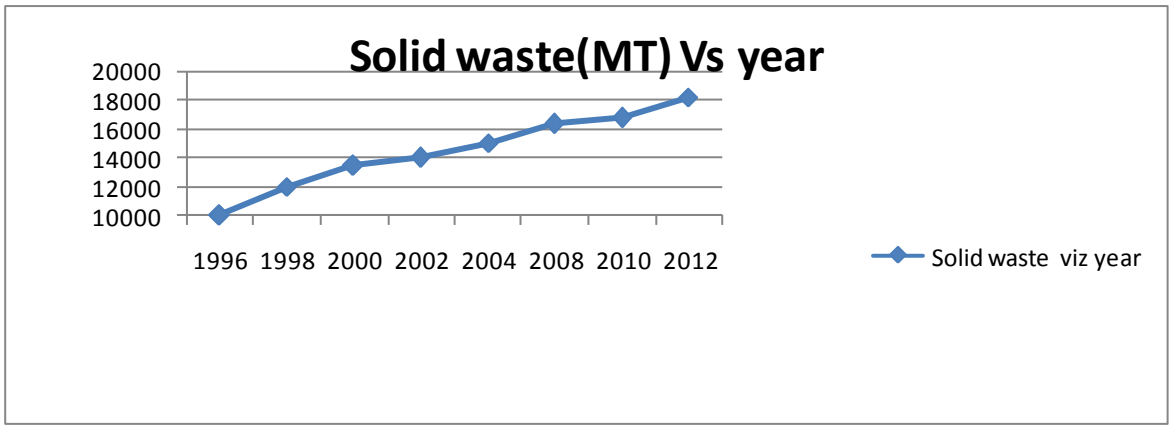
So these varieties of sea foods are used for the purpose of feedstock for poultry development at cheaper cost. The government can take necessary steps to collect all sea food wastages and convert it into biomass electricity.

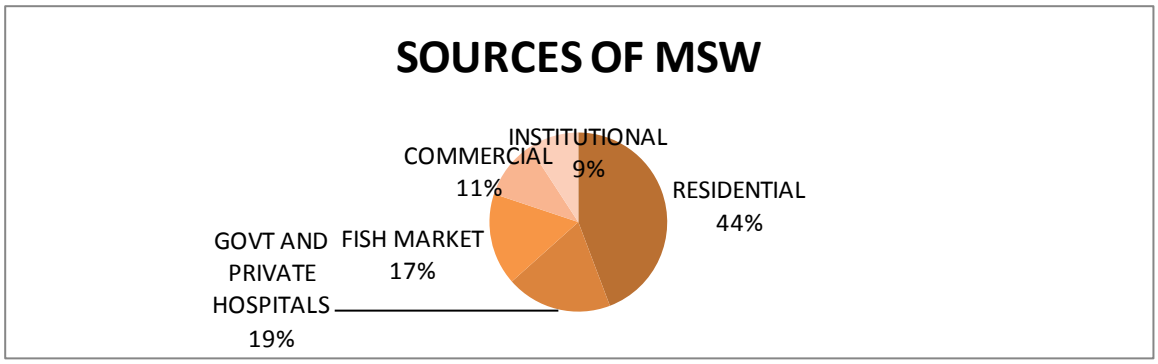
FISH WASTE TO FERTILIZER: Adding fish waste to the lawn and garden works as a wonderful organic fertilizer. It adds important nutrients such as phosphorus, potassium and nitrogen to the soil. Compost fish waste by mixing it with peat moss or wood chips to make garden mulch. This quickly produces excellent compost for use in the marina gardens without any odor problem.

WASTAGE MANAGEMENT: Nagapattinam faces significant gaps in sanitation. Further, Solid Waste Management is another critical area of concern in the town.

Particular	*Male*	*Female*	*Total*
Population	46155	46933	93148
Literates	36300	32010	68310

Nagapattinam town generates around 55 MT of waste every day. Other than residential sources, commercial and institutional establishments contribute nearly 15-20% to the total waste generated by the town. Managed by the health department of the local body, waste is collected by 6 vehicles from 25 collection points of the town on a regular basis. On an average 50 MT of waste is being collected from all the health zones and disposed off through dumping by the agency with a collection efficiency of 91%.





DUMPING /COMPOSTING YARD: At present, waste is disposed off through dumping in a disposal yard outside the town. The disposal yard is situated at a distance of about 5 kilometers from the town and is spread over an area of 19 acres. While disposal area is sufficient for the next 20 years, the disposal currently is only through dumping. NM (Nagapattinam Municipality) is in the process of implementing measures to develop the dumping yard and implement composting.

The municipality has also given land to Exnora for setting up a vermi composting facility. Exnora is currently doing door-to-door collection in 3 wards and in market area with 7 tricycles and is producing about 500 kg of compost per month. However, they are facing difficulties in selling the same. NM could explore further developing this area as a transfer station to segregate the waste. Given that Exnora is not able to market the compost commercially, the same can be used to create horticultural produce with this area and also used for urban forestry projects and for avenue trees in and around Nagapattinam.

IV. MATHEMATICAL MODEL FOR SOLVING TRANSPORTATION PROBLEM

Nagapattinam town generates around 55 MT of waste every day. Waste is collected by 6 vehicles from 25 collection points of the town on a regular basis. The disposal yard is situated at a distance of about 5 kilometers from the town and is spread over an area of 19 acres.

Efficient algorithms have been developed for solving the transportation problem when the unit costs, supplies and demands are known exactly. But most of the real life problem does not know the exact quantity of supply and demand. The transportation costs may vary with time. Therefore the ability to define and to determine the optimal solution of the transportation problem is necessary, in which the unit transportation costs, supplies and demands are all interval number. The interval transportation problem is the problem of minimizing interval valued objective function with interval source and interval destination parameters which can be stated as follows

$$\min z = \sum_{i=1}^{m} \sum_{j=1}^{n} [\, c_{Lij}, c_{Rij}] x_{ij}$$

subject to the constraints

$$\sum_{j=1}^{n} xij = [aLi, aRi] \ ,i = \ 1,2, \ldots . m \quad \sum_{i=1}^{m} xij = [bLj, bRj] \ ,j = \ 1,2, \ldots . m$$

$$\sum_{j=1}^{n} xij \geq 0, i = \ 1,2, \ldots . m, j = 1,2 \ldots n \text{ with } \sum_{i=1}^{m} aLi = \sum_{j=1}^{n} bLj \text{ and } \sum_{i=1}^{m} aRi = \sum_{j=1}^{n} bRj$$

Where $[c_{Lij},c_{Rij}]$ is an interval representing the uncertain cost for the transportation problem. It may represent delivery time, quantity of goods delivery, capacity etc., The source parameter lies between left limit a_{Li} and right limit a_{Ri} , similarly, destination parameter lies between left limit b_{Lj} and right limit b_{Ri}.Source and destination parameters respectively lie within the intervals $[a_{Li},a_{Ri}]$ and $=[b_{Li},b_{Ri}]$ and like the conventional one, we assume that this is a balanced transportation problem. Though, for a balanced problem $[a_{Li},a_{Ri}]$ and $=[b_{Li},b_{Ri}]$ need not simply be assumed to be identical to each other, instead , these parameters are required to be non inferior to one another, that is one interval parameter may be nested in another but they should be equi-centered[7].

Sengupta[1] and Pal proposed a simple and notable index for comparing any two intervals on the real line. Sengupta etal proposed a method to solve interval transportation problem by considering the midpoint and width of the interval in the objective functions. Midpoint is the average of the left limit and right limit. Width is the difference of right limit and left limit ,divided by two.

$$X = \frac{aL + aR}{2}$$

$$Y = \frac{aL - aR}{2}$$

where X is the midpoint and Y is the width. The source parameter lies between left limit a_{Li} and right limit $a_{Ri.}$

Let us consider a real life situation where the objective is to minimize Z.

$$\min z = \sum_{i=1}^{m} \sum_{j=1}^{n} [\, c_{Lij},c_{Rij}]x_{ij}$$

where c = $\begin{bmatrix} [1,3][1,2][1,4][2,4] \\ [3,4][3,6][1,3][3,4] \\ [1,2][1,4][4,5][2,5] \end{bmatrix}$

Subject to the constraints

$$\sum_{j=1}^{4} x1j = [5,8], \sum_{j=1}^{4} x1j = [2,5], \sum_{j=1}^{4} x1j = [9,11]$$

$$\sum_{i=1}^{3} xi1 = [2,6], \sum_{i=1}^{3} xi2 = [5,9], \sum_{i=1}^{3} xi3 = [10,20], \sum_{i=1}^{3} xi4 = [3,8]$$

where $x_{ij} \geq 0$, i= 1,2,3 and j=1,2,3,4

The objective function is to minimize Z that is to minimize the midpoint and width of Z

Min z= {min (X(z),MinY(z)} subject to

$5 \leq x_{11} + x_{12} + x_{13} + x_{14} \leq 8$

$2 \leq x_{21} + x_{22} + x_{23} + x_{24} \leq 5$

$9 \leq x_{31} + x_{32} + x_{33} + x_{34} \leq 11$

$2 \leq x_{11} + x_{21} + x_{31} \leq 6$

$5 \leq x_{12} + x_{22} + x_{32} \leq 9$

$10 \leq x_{13} + x_{23} + x_{33} \leq 20$

$3 \leq x_{14} + x_{24} + x_{34} \leq 8$

where $x_{ij} \geq 0$, i= 1,2,3 and j=1,2,3,4

$X(z)= x_{11} + 0.5x_{12} +1.5\ x_{13} + x_{14} +0.5x_{21} +1.5\ x_{22} + x_{23} +0.5\ x_{24} +0.5x_{31} +1.5\ x_{32} +0.5\ x_{33} +1.5\ x_{34}$

$Y(z)=2x_{11} +1.5x_{12} +2.5x_{13} +3\ x_{14} +3.5x_{21} +4.5\ x_{22} +2\ x_{23} +3.5\ x_{24} +1.5x_{31}+2.5\ x_{32} +4.5\ x_{33} +3.5\ x_{34}$

Using fuzzy programming technique this problem can be solved. The problem can also solved by the Linear Interactive and Discrete Optimization (LINDO) Software.

V. CONCLUSION

The urban local authorities realized the importance of sharing responsibilities with other partners in the city to solve the municipal solid waste management problems more effectively. Setting up and managing the recycling centre in Nagapattinam will help us to generate power through solid waste management. In this paper the concept of interval transportation problem is linked with the transportation of municipal solid waste to the collection point where the demand and supply is not known exactly. New contributions are required for producing energy from renewable energy sources and that will help for the growth of the country.

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