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ORIGINAL ARTICLE

SELECTION OF SUITABLE ENERGY SOURCES FOR TIKPUR VILLAGE IN WEST SIKKIM

AMIT KUMAR ROY AND B.B.PRADHAN

Sikkim Manipal Institute of Technology, Sikkim.

Abstract:

In the age of modern techniques for energy conservation & energy renewal, there are many areas in all parts of the world which are confronted with energy issues. Specially a state like Sikkim in a developing country like India, where most of the population is settled in remote areas of the Himalayan range & is still deprived of many technological benefits, needs to be studied carefully to draw a fruitful conclusion so that the study can prove helpful to everyone (public or govt.) in overcoming the issues.

This paper studies the preference modes of renewable energy sources in a village "Tikpur" of Sikkim. Through this paper, a clear understanding of the fact that wood has always been & will always be the most suitable source of fuel for the concerned population. A calculation has been done to prove the fact using figures that due to the changing economy & price variation in LPG, the public of Tikpur prefers wood to gasifier & gasifier to LPG

KEYWORDS:

Sources , Selection , modern techniques , industrialization.

I.INTRODUCTION:

The shortage of energy is a major problem for the development of undeveloped or developing state or country. Although shortage of energy exists in every country more or less, but the third world country suffers most because of unplanned industrialization and unmodified equipment and production process. Sikkim is also a very small Himalayan state of India. Although it has abandoned scope for hydel power plant and government is working on it, but when we see Sikkim as a state, the power produced in Sikkim is distributed to whole country through national grid. In Sikkim's village the people depend on traditional source of energy which supplies more than 90% of total energy used causing fast deforestation, decreasing soil fertility, etc. So, at last the village of Sikkim may not get sufficient power for there utilizations & we need to trap other alternative local energy sources for the optimum utilization of these sources as alternate energy sources. The objective of this paper is to find the best suitable local available energy sources or energy produced by local sources with conventional energy sources and compare "which one is the best among all for usage". As we know the alternative energy sources have its own advantages like:

1.Providing Better Lighting
2.Helping the Environment
3.Providing sustainable fuel systems
4.Benefitting the female population
5.Benefit human health & related issues.
6.Enhancing incomes.

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7.Reducing dependency on conventional fuels.

The selection of best suitable fuel for the villages in Sikkim is very typical. The topography of Sikkim is such that the fuel supplied to the remote villages should be reliable and cost effective. Some times we can observe that the conventional fuels have upper hand over non conventional fuel due to the topography, climate and feasibility to construct alternative energy supply system due to lesser population. In this paper Topsis approach is used to rate and choose the best alternative energy sources available for Tikpur village in Sikkim. The sections in this paper are organized as below:

First, we present the past research works done in the same sector by the researchers in section 2. Then research design and application of Topsis method is discussed on energy selection problem in section 3. Section 4 discusses the sensitivity analysis. Finally, discussion and conclusion is made in section 5.

II. LITERATURE SURVEY

Das(1987) developed a multi objective linear programming based model to analyze the renewable energy policy for Tamil Nadu.[1] Satsangi and Sarma (1988) discussed the possible options for meeting the energy requirement for development of india for the year 2000-01, Cost minimization was the objective of the model.[2] The TESOM & BESOM was discussed by Andy s. Kedes (1990) to examine

inter-fuel Substitutions[3]. MPEEE model has been developed by Suganthi L. and Jogadeesan T.R (1992). This model increase the GNP/energy ration to meet the requirement of energy for year 2010-2011 for India[4].Mustafa Tiris et.al.(1994),has worked on linear optimization model and a multi- attribute value model to estimate the long term energy, economy and environment impact for Turkey.[5] Raja et al.(1997) has presented an energy planning optimization model using linear programming technique for sustainable development in agriculture. His model had been developed based on the availability of various energy sources in the block. [6] A.K.Roy et.al.(2012) has done analysis of various energy sources for energy planning using AHP for Sikkim State.[7] Mr. A.K.Sinha and Mr. Surekha Dudhani had allocated optimal shave of renewable energy resources with varying technological and cost coefficients by linear programming based methodology.[8] Agrawal and Sinha(2001), made A fuzzy based multi-objective analysis for the energy allocation for cooking in UP.[9]

III. RESEARCH DESIGN

The research for this particular study has been done in the following way

1.Preparation of survey questionnaire: The survey of the concerned village has been done with the help of structural written questioners which depicts information of the basis of the primary and secondary data collected during the survey.
2.Data Collection: The data collection for selection of suitable energy for the Tikpur village was 100% coverage basis.
3.For the selection of suitable energy source for Tikpur Village, “Topsis Method” has been applied to reach the results.
4.Based on the results, an analysis of the entire study has been done to draw an appropriate conclusion.

IV. TOPSIS APPROACH

Topsis was developed by Hwang and Yoon to evaluate rate & rank alternatives against some given factors. In order to apply Topsis for the selection of best energy sources, following points should be considered.

1.Each attribute in decision matrix takes either monotonically increasing or monotonically decreasing utility.
2.A set of weights for the attributes is required.
3.Any outcome which is expressed in a non-numerical way, should be quantified through the appropriate scaling technique.

The Calculation processes for this method are shown below:

Step One: Construction of the Normalized Decision Matrix

To transform various dimensional attributes into non dimensional attributes to allow comparison between attributes.

Step Two: To calculate and construct the weighed normalized decision matrix.

It cannot be assumed that each evaluation criterion is of equal importance because each evaluation criteria has its own importance. There are many methods by which weight can be determined. Here we have taken AHP method to find weight. The weighted normalized evaluation matrix can be calculated by multiplying the normalized evaluation matrix rij with its associated weight wj to obtain the result.

$$V \quad w_j r_{ij} = [V_{ij}]$$

Step Three: To determine the Ideal and Negative Ideal Solutions:
The positive idea solution is represented by A+ means most preferable alternatives, and the negative idea solution A- means the least preferable alternative.

$$A \quad {}^{\max}{}_i V \mid j \quad J \;,\; {}^{\min}{}_i V_{ij} \mid j \quad J \mid i \quad 1,2,\ldots m$$

$$A \quad {}^{\min x}{}_i V \mid j \quad J \;,\; {}^{\max}{}_i V_{ij} \mid j \quad J \mid i \quad 1,2,\ldots m$$

J associated with cost factor
j associated with benefit factor

Step Four: To Calculate the Separation Measure

$$S_i \quad \sqrt{\sum_{j\ 1}^{n} (v_{ij} \quad v_i)^2} \qquad i = I, 2, \ldots\ldots, m \text{ for ideal separation.}$$

$$S_i \quad \sqrt{\sum_{j\ 1}^{n} (v_{ij} \quad v_i)^2} \qquad i = I, 2, \ldots\ldots, m \text{ for negative ideal separation.}$$

Step Five: To Calculate the relative Closeness to the Ideal Solution.

$$C_i^* \quad \frac{S_i}{S_i \quad S_i} \;,\; 0 \quad i = 1,2\ldots\ldots,m$$

$C_i^* \quad 1$ if $A_i = A^+$
$C_i^* \quad 0$ If $A_i = A^-$

Step Six: Ranking the preferences.
Different alternatives can now be preference ranked according to the descending order of C*i

V. AN APPLICATION & ANALYSIS

The selection of best suitable fuel for the villagers of Tikpur village can be done by many ways. In this research we are applying Topsiss method for selecting the best suitable fuel for the villagers and for this research we are considering the following criteria.

1.Cost of energy
2.Reliability
3.Technology

Also in this research we have considered three alternative sources like LPG, Wood & Gasifier

First Step: Now in first step we are evaluating all the energy sources with different criteria.

source	cost/day	Avability	Acceptance
LPG(E1)	30	8	9
Wood(E2)	2	6	4
tGasifire(E3)	2	4	7

Second Step: Now normalizing the above matrix

source	cost	Avability	Acceptance
LPG(E1)	0.995584967	0.742781353	0.7448453
Wood(E2)	0.066372331	0.557086015	0.331042355
gasifire(E3)	0.066372331	0.371390676	0.579324122
Weight(By AHP method)	0.476	0.176	0.081

Weight taken from AHP problem.

Third Step: Weight Decision Matrix

Source	Cost	Avability	Acceptance
LPG(E1)	0.473898444	0.130729518	0.060332469
Wood(E2)	0.03159323	0.098047139	0.026814431
gasifire(E3)	0.03159323	0.065364759	0.046925254

Fourth Step: To determine the positive idea and negative idea solution.

A+ =	0.03159323	0.130729518	0.060332469
A- =	0.473898444	0.065364759	0.026814431

Fifth Step: Calculating the separation measure

S1+ = 0.442305214
S2+ = 0.046814494
S3+ = 0.066725596

S1- = 0.073457543
S2- = 0.443511038
S3- = 0.44276218

Step VI: To find relative closeness

E1(Gas) = 0.142425063
E2(Wood) = 0.904523647
E3(Gasifire)= 0.869033961

So the preference is given to:

1.Wood
2.Gasifire
3.LPG

SENSITIVITY ANALYSIS

A mathematical model has been proposed to combined cost factor components with the relative closeness found by Topsiss method.

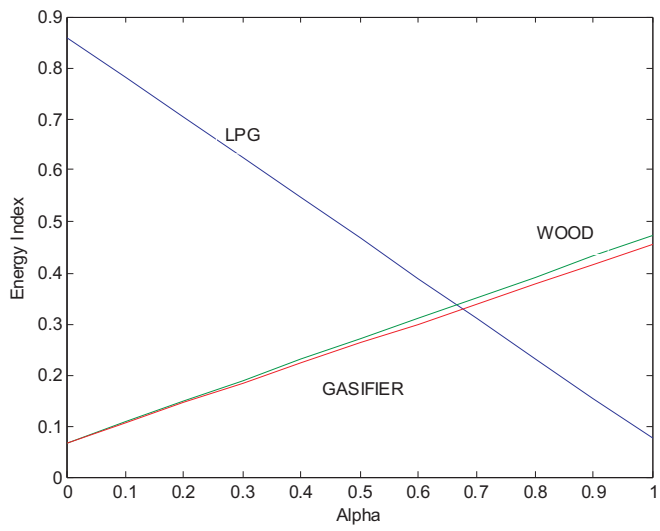
$EIi = \alpha * SFW + (-\alpha)*OFW$ .....(1)

EI = Energy Index

A = attitude of indication

$OFWi = [OFCi\ \Sigma ni=1OFC-1]-1$ .....(2)

OFW = Objective Factor Weight
SFW = Subjective Factor Weight
n = Number Of Alternative Energy = 3 (in this case)



Relative closeness represents the SFW. OFCs are the cost for each energy sources.OFW should be designed in such a way that it gives non dimensional quantity of cost components of each fuel. It can be used for combining cost component of each fuel or energy with SFW values. The values of SFW are used in Equation -1. The OFCs are in Rupees and OFW values are non dimensional quantities. The values of α is taken from the villagers.. The sensitivity plot is shown in Fig.

DISCUSSIONS AND CONCLUSION

The suitable energy selection is the key of sustainable development. Various methods have been proposed to analyze energy source selection. In this paper two methods has been implemented to select and analyze the suitable energy sources. All the three sources of energy have their importance at their own places and none of them can be ignored. However, since being a study of particularly Timkur Village in Sikkim, this paper majorly focuses on the various technical, social and economic aspects of the region to prove by all statistical tools that the most preferred source of energy is wood as compared to gasifier and LPG. The energy source selection is done with the help of Topssis method and result is the wood has a upper hand over the gas from gasifire and LPG. It is due to the increase in the cost of LPG. Further with the help of

sensitivity analysis (Fig-1) we can see that if cost of LPG increases, there will be a change in the attitude of around more than 65 % of the total population and they eventually they would prefer wood to LPG.

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AMIT KUMAR ROY
Sikkim Manipal Institute of Technology, Sikkim.

B.B.PRADHAN
Sikkim Manipal Institute of Technology, Sikkim.