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Energy Potential of Elephant Camp: The Preliminary Study of Maewin sub district, Chiang Mai, Thailand

Tidarak Pooya[1], *Sopee Pan-in*[1], *Hathaithip Sintuya*[1], *Chayanon Sawatdeenarunat* [1,*]

1 Asian Development College for Community Economy and Technology, (adiCET)
Chiangmai Rajabhat University, Thailand 50180
**Corresponding author: chayanon@cmru.ac.th*

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CORRESPONDING AUTHOR

*E-mail: chayanon@cmru.ac

A B S T R A C T

This research aims to examine the energy potential of the elephant camps located in Tumbon Maewin, Apmphoe Maewang, Chiang Mai, Thailand.A questionnaire survey was given to the research participants. The questions mainly focused on the energy consumption, monthly budget for buying energy, and their understanding on energy. The results from the participants in 16 elephant camps, handling 133 animals, indicated that the camps paid more than 3000, 10000, and 400 baths in average monthly for electricity, fuel oil, and cooking gas, respectively. However, the generated elephant dung of 4 tons per day has the gross and net heating values of 63600 and 58600 MJ which can be used as a renewable resource to produce renewable energy for replacing the fossil fuels serving the elephant camp activities.

1. INTRODUCTION

The elephant Camp in Mae win subdistrict is located in the central of Chiang Mai province. The geographic location of this community is complex which consists of highlands and rainforest timber elephant camps. It was found in the majority of the fuels used in the elephant camp is cooking gas for serving the tourist activities. With respect to the animal raising, there are a lot of elephant dung generated in the camp and has not been utilized. Besides, this wasted material could negatively affect the downstream environment and community because most of the camps are located nearby the rivers in order to use water for serving the activities. Elephant dung, a biodegradable biomass, can be used to produce renewable energy via biological process, such as anaerobic digestion to produce biogas to replace LPG for cooking and/or to produce heat and hot water using thermos - chemical process. Therefore, converting elephant dung to energy can significantly reduce the cost of the elephant camps well as increase the income following the sufficiency economy philosophy of King Rama IX of Thailand. However, the application of the appropriate technology plays a key role in this scenario. The main objective of this research is to preliminary determine the energy potential of the elephant camp in Mae Win Subdistrict.

2. MATERIALS AND METHODS

Firstly, the field survey was conducted to collect the data from the elephant camp in Mae win subdistrict. The questionnaire was divided into 5 parts which are general data, energy usage waste production and management, elephant characteristic and understanding of renewable energy. Secondly, elephant dung was collected to conduct the thermal property and elementary analysis using the standard method described in [1]. Elephant dung was stored in the refrigerator at 4 degrees before being analyzed..

3. RESULT AND DISCUSSION

There were 16 elephant camps returned the questionnaire. The total elephants in the camps were 133 animals which could generate elephant dung of 4 tons per day. The results of the thermal characteristics and elementary analysis are presented in Table 1.

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Table 1. Thermal characteristics and elemental contents of the generated elephant dungs

No.	Parameter	Unit	Analytical method	Valve
1	Moisture (As received basis)	% wt.	Gravimetric method	13.17 ± 0.61
2	Carbon (C) (As dried basis)	% wt.	CHNS/O Analyzer	42.312 ± 0.062
3	Hydrogen (H) (As dried basis)	% wt.	CHNS/O Analyzer	5.689 ± 0.084
4	Nitrogen (N) (As dried basis)	% wt.	CHNS/O Analyzer	1.734 ± 0.017
5	Sulfur (S) (As dried basis)	% wt.	CHNS/O Analyzer	0.080 ± 0.002
6	Oxygen (O) (As dried basis)	% wt.	CHNS/O Analyzer	38.721 ± 0.062
7	Gross Heating Value (G.H.V) (As dried basis)	% wt.	CHNS/O Analyzer	3,760.916 ± 27.405
8	Net Heating Value (N.H.V) (As dried basis)	% wt.	CHNS/O Analyzer	3,469.028 ± 23.195

Based on the amount of the generated elephant dung and the properties in table 1. The generated dung has the net and gross heating value of 63600 and 58600 MJ. From the presented heating value, by using the dung to produce heat could replace LPG up to 1266.42 kg/day which could cut down the cost of 33,180 baht daily. The ultimate analysis results indicated that the elephant dung consisted of carbon (C) 42.312 ± 0.062% wt., Hydrogen (H) 5.689 ± 0.084% wt., Nitrogen (N) 1.734 ± 0.017 wt., Sulfur (S) 0.080 ± 0.002% wt. And Oxygen (O) 38.721 ± 0.062% wt. The Theoretical Methane Potential (TMP) could be calculated from the stoichiometric as shown in the equation below:

$$C_aH_bO_cN_dS_e + \left(a - \frac{b}{4} - \frac{c}{2} + \frac{3d}{4} + \frac{e}{2}\right)H_2O \rightarrow \left(\frac{a}{2} + \frac{b}{4} - \frac{c}{4} - \frac{3d}{8} - \frac{e}{4}\right)CH_4 + \left(\frac{a}{2} - \frac{b}{8} + \frac{c}{4} + \frac{3d}{8} + \frac{e}{4}\right)CO_2 + dNH_3 + eH_2S$$

From the equation, the anaerobic reaction could be presented as:
$C_{42.3}H_{5.7}O_{38.7}N_{1.7}S_{0.1} + {}_{22.9}H_2O \rightarrow {}_{12.2}CH_4 + {}_{30.8}CO_2 + {}_{1.7}NH_3 + {}_{0.1}H_2S$

The calculated TMP indicated that the elephant dung had the methane potential of 273.3 L/mol at STP 300.6 L/mol at 30˚C. The expected methane could be used to replace LPG for enhancing the economic viability of the camp and mitigate the environmental issues.

4. CONCLUSION

From the data of 16 elephant camps in Maewin sub-district, it is found that to the generated elephant dung has potential to serve as the substrate for producing many forms of renewable energies (i.e. heat and biogas) for being utilized the camps. This waste-to-energy concept can not only save the cost of the camps but also enhance the environment of the community downstream. The hygiene of the community member could be improved which results the better quality of life.

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1. Asian Development College for Community Economy and Technology
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3. Owner of 16 elephant camp

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