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A STUDY ON ELECTRICAL ENERGY CONSERVATION PRACTICED IN SHOP FLOOR MANAGEMENT OF SELECT OIL MILLS IN KANGAYAM, TIRUPUR DISTRICT, TAMILNADU

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Abstract:

Electricity is an important driver for industrial and agricultural growth. Electricity plays a vital role in improving quality of life. Energy conservation means reduction in use of energy consumption and is measured in physical terms. Conservation of electricity is also necessary to save the environment and the Earth from warming. One cannot afford to waste electricity at all. Switching off electricity when not needed, maximum use of natural light and air, use of energy efficient equipments of correct size, refurbishing of electricity gadgets and motors in operation, etc. are some of the simple methods, which save electricity. This practice may result in increase of financial capital, environmental value, national security, personal security and human comfort. So it is the responsibility of society to look at the problem more seriously and make an attempt to ensure proper and judicious use of electricity. In this context, the present study identified the nature of oil mill business, awareness of the electricity conservation practices among oil mills and the problems faced by the oil mills in installing the conservation techniques in Kangayam, Tirupur District.

Key Words: Energy Conservation, Energy Efficiency & Electrical Energy

Introduction:

The development of any state depends to a large extent on availability and usage of electricity. Conservation of electricity is more essential due to the concern for fast depletion of non-renewable sources of energy in the country. It will be a contribution of both the power distribution utility and its consumers for a better tomorrow. So they have to work together with its consumers for raising awareness on need to conserve electricity. Educating the general public on the methods of conservation of electricity and possibilities of spending less on electricity can go a long way in reducing electricity requirements. Energy conservation also means reduction or elimination of unnecessary energy used and wasted. Energy conservation and energy efficiency are often used interchangeably, but there are some differences. At the most basic level, energy conservation means using less energy and is usually a behavioural change, like turning your lights off or setting your air conditioner lower. Energy efficiency, however, means *using energy more effectively,* and is often a technological change. Energy efficiency measures the difference between how much energy is used to provide the same level of comfort, performance or convenience by the same type of product, building or vehicle.

Review of Literature:

The study of related literature and research work is very essential and important as it provides us proper guidelines. This part of the study deals with the review of related literature which is presented below.

J. P. Saxena, Sushil and Prem Vrat (February, 2011) Impact of indirect relationships in classification of variables—a micmac analysis for energy conservation The paper presents the methodology for identification of key variables based on direct as well as indirect inter-relationships which, often, may not be clearly visible. The

successful application of methodology has then been demonstrated in a case study for energy conservation in the Indian cement industry.

S. Sadrzadehrafiei, K. Sopian S. Mat, C. Lim (April 2012) Energy consumption and energy saving in Malaysian office buildings This study estimated the energy savings potentially achieved by installing insulation material in the external walls and applying advanced glazing to a typical mid-rise office building in Malaysia. IES (Integrated Environmental Solution) software was used to model the office building and for thermal performance analysis.

Jeffrey M. Ulmer, Troy E. Ollison (2012), describes that manufacturing managers need to understand the interrelated links between advanced manufacturing technology, primary and alternative energy choices, energy output values and costs, and energy conservation over the life of a project. Through an overview of these topics and the manager's energy conservation processing optimization model developed in this paper gain greater insight to the impacts of energy technologies upon manufacturing activities.

Kuo-Ming Chao, Shah, N., Farmer, R., Matei, A., Ding-Yuan Chen, Schuster-James, H., Tedd, R. (2012) describes that climate change is one of the driving forces behind a new wave of energy management systems. Although these systems play a crucial role in providing a detailed picture of energy consumption in home environment and contribute towards influencing the energy consumption behaviour of household, they all leave it to households to take appropriate measures to reduce their energy consumption.

Irawati Naik, Prof.S.S.More, Himanshu Naik (2012) describe that energy is crucial to human sustenance and development. Due to the deficiency in power generation, day by day the gap between demand and supply of electric energy is widening. Bridging this gap from the supply side is very expensive. Hence energy management program is a systematic and scientific process to identify the potential for improvements in energy efficiency, to recommend the ways with or without financial investment, to achieve estimated saving energy and energy cost.

Biswajit Biswas, Sujoy Mukherjee, Aritra Ghosh (2013) in their study Conservation of Energy: a Case Study on Energy Conservation in Campus Lighting in an Institution it was found that the improvement of end user efficiency with proposed higher efficient LED light fixture provide significant result for campus lighting system. It was also found that the initial investment is high and the payback period is slightly above 3 years. It was also found that around 65% of annual energy consumption can be reduced with the proposed scheme.

Statement of the Problem:

Recognizing inefficiencies in existing energy utilization, the Government of India enacted the energy conservation act in 2001 with a view to provide a legal and institutional framework to enable the economy to become energy efficient. This can be achieved only with active participation of all stakeholders particularly Power Utilities and consumers. Industrial sector plays a crucial role in rapid and balanced development of the state. To tackle the rapidly rising cost of energy, large and organized industries have adopted energy conservation and efficiency measures through the enhancement of technology. However, such improvements have not been achieved by small and medium enterprises. This may be due to lack of skilled and technical management personnel, capital limitations or lack of information. Many of these industrial units suffer from lower productivity due to out-dated technology, poor operation and maintenance practices and use of old machines/motors. Machineries are the largest end users of the

electricity in the industrial sector. High efficiency motor rewinding and use of motors of proper capacity and proper load can save electricity considerably. From brief review of existing literature on energy conservation it is observed there is not a single research which has focused on finding out the problems in electrical energy conservation in small scale industries and in particular the oil mills.

Objectives of the Study:

The main objective of this study is to explore the energy conservation practices followed in the oil mill units at Kangayam.

Other objectives:

- ✓ To find out the level of awareness and utilization of energy conservation among oil mill owners
- ✓ To study energy conservation techniques followed in oil mills
- ✓ To find out the problems faced by the oil mills in electrical energy conservation

Methodology:

The research methodology for the present study includes data source, sample size, sampling technique, tools of data collection and tools of analysis.

Source of Data:

The present study is largely based on the primary data. Required primary data have been collected in the course of interview with the oil mill owners by means of well structured Questionnaires. The required secondary data have been collected through Annual Reports of Ministry of New and Renewable Energy (MNRE), various journals, periodicals and web sites.

Sample Size and Procedure Adopted:

To construct the sample, data available in Coconut Oil Manufactures Association were taken into consideration. Since there are nearly 63 oil mills, 4 oil mills which are not in operation were excluded from the selection. So finally, sample size consisted of 59 mills. Area-wise distribution of mills is Kangayam - 42; Padiyur-07; Muthur - 02; Kadaiyur - 02; others - 06.

Statistical Tools UsedL:

The data collected from the respondents were entered in the master table from which numbers of tables were prepared according to the needs of the study. The techniques used for the analysis of data are percentage, Henry Garrett Ranking Technique, ANOVA, Correlation and Multiple Regression Analysis

Limitations of the Study:

The study confined to energy conservation techniques practiced by the oil mills alone. Hence, the results arrived from the study may or may not be applied to other manufacturing units. The accuracy of the data depends on the accuracy of the information given by the respondent.

Analysis and Interpretation:

The demographic factors of consumers include variables such as age of the mill, nature of the organization, educational qualification of the owner or key person, no of employees, capacity of the machine, operating hours per week, operating area of the mill, annual production in the year 2015 and annual electricity consumption during the year 2015 which are presented in table No. 1

Table 1: Profile of the Respondent

Particulars	Numbers	Percentage
Location		
Urban	42	71
Rural	17	29

Age		
Below 10 years	26	44.1
Between 11-20 years	28	47.5
Above 20 years	5	8.4
Nature		
Sole proprietorship	18	30.5
Partnership	40	67.8
Private Limited Company	1	1.7
Educational Qualification		
No Formal Education	14	23.7
School level	25	42.4
College level	20	33.9
Professional	0	0.0
Annual Production		
2000-2500	37	62.7
2501-3000	13	22.0
3001-5000	9	15.3
Number of Employees		
Upto 20 Employees	34	57.6
21-30 Employees	10	16.9
Above 30 Employees	15	25.5
Number of Operating Hours/Week		
Upto 48 hours	30	50.8
49-55 hours	17	28.8
Above 55 hours	12	20.4
Electricity Consumptions in Units		
Below 50000 units	31	52.5
50001-200000 units	18	30.6
Above 200000 units	10	16.9
Types of Machine		
Old machine	31	52.5
New machine	10	16.9
Both type	18	30.6
Capacity of The Machine		
30 HP	28	47.5
60 HP	22	37.3
100 HP	9	15.2
Electricity Expenses Per Annum		
Below Rs.350000	38	64.4
Rs.350001 – Rs.700000	15	25.4
Above Rs.700000	6	10.2
Area of The Mill		
Below 10000 sq. ft.	33	55.9
10001-15000 sq. ft.	17	28.8
Above 15000 sq. ft.	9	15.3

Source: Primary Data

From the table No. 1 it is found that 71 per cent of the mills are located in urban (Kangayam) area. The Majority (47.5%) of the mills are at the age between 11 – 20 years i.e. started between 1997 and 68% of the mills are come under the partnership type of firm. The majority (42.4%) of the key persons of the mills are having school level education alone. 63 percent of the mills are producing 2000-2500 tonnes annually, 58% percent of the mills are employed only up to 20 workers and 51 percent of the mills are working up to 48 hours per week. The majority (53%) of the mills are consuming below 50 000 units (kWh) annually and spending below 3.5 lakhs p.a.for

electricity expenses. The Majority (47.5%) of the mills are using 30 HP machines for production purposes and are operated on below 10 000 sq.ft.

Henry Garrett Ranking Technique:

Necessity to Conserve Electrical Energy:

Factors like reduce electricity bill, save natural resources for future, reduce pollution, reduce emission of green house gases, help the world to meet energy requirement and avoid global warming have been used in the Final Interview Schedule. By way of giving these factors in the Final Interview Schedule, Mill owners have been called to assess each factor on its own significance. Each owner is instructed to indicate the importance of the influencing factor by giving rank 1 to the most important factor, rank 2 to the second important factor and so on. To find the most significant factor influencing the select mills, Garrett's Ranking Technique is employed. It is calculated as percentage score and the scale value is obtained by employing Scale Conversion Table given by Henry Garrett which is shown in table No. 2

Table 2: Opinion of the Respondent about the Necessity to Conserve Electrical Energy

No.	Statements	Total Score	Mean Score	Rank
1	Reduce Electricity Bill	3996	67.7	I
2	Save Natural Resources for Future	2588	43.9	IV
3	Reduce Pollution	2286	38.7	VI
4	Reduce emission of green house gases	2462	41.7	V
5	Help the world to meet energy requirement	3253	55.1	II
6	Avoid Global warming	3170	53.7	III

Table No.2 makes known that reduce electricity bill took the first place which has the mean score of 67.7 followed by help the world to meet energy requirement, avoid global warming, save natural resources for future, reduce emission of green house gases and reduce pollution which has the least mean score of 38.7.

Obstacles Faced In Installing Energy Conservation Technique:

This technique was used to rank the problems faced by the mill owners in installing the energy conservation technique In this method, the respondents were asked to rank the given problem according to the magnitude of the problem. The order of merit given by the respondents was converted into ranks by using the following formula.

$$100 (Rij – 0.5) \text{ Percentage Position} = N$$

The percentage position of each rank thus obtained is converted into scores by referring to the table given by Henry Garrett. Then, for each factor, the scores of individual respondents were added together and divided by the total number of respondents for whom the scores were added. These mean scores for all the factors were arranged in order of ranks and inference was drawn.

Table 3: Obstacles Faced In Installing Energy Conservation Technique

No.	Obstacles	Total Score	Mean Score	Rank
1	Higher cost of energy efficient products	3215	54.5	I
2	Non-availability of certified energy efficient products	3014	51.1	II
3	Lack of technical know-how	2731	46.3	IV
4	Lack of skilled labour in installation	2869	48.6	III

As per table No.3, higher cost and non availability of certified energy efficient products ranked I and II respectively according to Henry Garrett Ranking Technique. Lack of skilled labour and technical know-how in installation of technique were positioned in 3rd and 4th place respectively.

Reasons for Not Using the Energy Saving Appliances:

While analyzing the energy conservation practiced in oil mills, it is found that there are mills which are not using the energy saving appliances. There are different hindrances for not using energy saving appliances which are ranked into a table No.4 with the help of Henry Garrett Ranking Technique.

Table 4: Reasons for Not Using the Energy Saving Appliances

No.	Reasons	Total Score	Mean Score	Rank
1	High cost of appliances	3501	59.3	I
2	Short span of life	2905	49.2	III
3	Less availability	2980	50.5	II
4	Less awareness	2414	40.9	IV

Table No. 4 has shown the ranks for not using energy saving appliances in production process. According to this High cost of appliances ranked I followed by Less availability of products. Further, Short span of life and Less awareness ranked III and IV respectively.

Anova Analysis:

The acronym ANOVA refers to analysis of variance and is a statistical procedure used to test the degree to which two or more groups vary or differ in an experiment. In most experiments, a great deal of difference usually indicates that there was a significant finding from the research. In this section, the perception of respondents towards energy conservation support from the government is taken as dependent variable and age of the company, educational qualification of key persons of the mill, number of employees, number of operating hours, capacity of the machine, annual production and operating area of the mill are taken as independent variables.

H_0: All the respondents are having equal perception towards energy conservation support from the Government with respect to their age of the company, Educational Qualification, Annual Production, Number of Employees, Operating Hours per Week, capacity of the machine and operating Area of the mills.

Table 5: Analysis of Variance (ANOVA)

Variables	Mean Score	SD	'F' Value	'p' Value
Age of the company				
Below 10 years	4.80	0.32	1.146	0.327^{NS}
Between 10-20 years	4.68	0.26		
Above 20 years	4.63	0.38		
Educational Qualification				
No Formal Education	4.62	0.28	1.667	0.200^{NS}
School level	4.74	0.35		
College level	4.82	0.23		
Professional	0	0		
Annual Production				
2000-2500 tonnes	4.77	0.29	0.481	0.621^{NS}
2501-3000 tonnes	4.71	0.29		
3001-5000 tonnes	4.67	0.35		
Number Of Employees				
Upto 20 Employees	4.76	0.25	3.992	0.025**
21-30 Employees	4.92	0.13		
Above 30 Employees	4.58	0.38		
Operating Hours				
Upto 48 hours	4.71	0.29	0.217	0.805^{NS}
49-55 hours	4.76	0.24		
Above 55 hours	4.77	0.39		

Capacity Of The Machine				
30 Hp	4.71	0.33	1.485	0.237^{NS}
60 Hp	4.82	0.24		
100 HP	4.54	0.26		
Operating Area				
Below 10000 sq. ft.	4.70	0.31	2.259	0.116^{NS}
10000-15000 sq. ft.	4.86	0.22		
Above 15000 sq. ft.	4.58	0.36		

Note: NS - Not Significant

It is divulged from the table No. 5 that among the three age of the company, below 10 years established companies got maximum level of perception and among the four categories of educational qualification of the respondents, college level qualified respondents got maximum level of perception towards energy conservation support from the Government. Regarding the oil companies which produce around 2000 to 2500 tonnes of oil every year got maximum level of perception towards energy conservation support from the Government.

It is also examined from the table that among the three categories of number of employees in the company, 21-30 employees working in the company got maximum level of perception and among the three categories of operating hours per week, above 55 hours operated per week oil companies got maximum level of perception towards energy conservation support from the Government. In the three categories of capacity of the machine, the oil mills which have 60 Hp machines got maximum level of perception and the companies which have 10000 to 15000 sq.ft. surface area got maximum level of perception towards energy conservation support from the Government.

It is discussed from the F test analysis that the null hypothesis is accepted with respect to variables viz. Age, Educational Qualification, Annual Production, Operating Hours per Week, Capacity of the Machine and Operating Area of the mills. Hence, it is found that all the selected respondents are getting equal level of perception towards energy conservation support from the Government.

It is also noted from the F test analysis that the null hypothesis is rejected in case of Number of Employees. Hence, it is found that all the selected respondents are not getting equal level of perception towards energy conservation support from the Government.

Correlation Analysis:

Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. The main result of a correlation is called the correlation coefficient (or "r"). It ranges from -1.0 to +1.0. The closer r is to +1 or -1, the more closely the two variables are related. If r is close to 0, it means there is no relationship between the variables. If r is positive, it means that as one variable gets larger the other gets larger. If r is negative it means that as one gets larger, the other gets smaller (often called an "inverse" correlation).

Null hypothesis: Age, Educational Qualification, Annual Production, Number of Employees, Operating Hours, Capacity of the machine, Operating Area of the company is not having significant association with their perception towards energy conservation from the Government.

Table 6

No.	Variable	'r' value	'p' value
1.	Age of the company	-0.212	0.139^{NS}
2	Educational qualification	0.256	0.072^{NS}

No.	Variable	'r' value	'p' value
1.	Age of the company	-0.212	0.139^{NS}
3	Annual production (in tonnes)	-0.141	0.328^{NS}
4	Number of employees	-0.226	0.114^{NS}
5	Operating hours per week	0.091	0.528^{NS}
6	Capacity of the Machine	0.035	0.811^{NS}
7	Operating area of the mill	0.019	0.896^{NS}

Note: NS – Not Significant

It is found from the analysis that the null hypothesis is accepted in case of Age, Educational Qualification, Annual Production, Number of Employees, Operating Hours, Capacity of the machine, Operating Area of the company. So, it is noted all the selected variables are not having significant association with their perception towards energy conservation from the Government.

Further, Age, Annual Production, Number of Employees of the company are having negative association with their perception and Educational Qualification, Operating Hours, Capacity of the machine, Operating Area of the company are having positive association with their perception

Level of Perception towards Energy Conservation Support from the Government – Multiple Regression Analysis:

The relationship between the selected independent variables and the dependent variable level of perception towards energy conservation support from the government has been found by using multiple regression analysis. The independent variables are age of the company, educational qualification, annual production (in tonnes), and number of employees, operating hours per week, capacity of the machine and operating area of the mill. The goal of the regression analysis is to see what extent the selected independent variables predict the dependent variable level of perception towards energy conservation support from the government. The result of the relationship between the independent and dependent variables is discussed in the table 7

Table 7: Level of Perception towards Energy Conservation Support from the Government – Multiple Regression Analysis

No.	Variables	Coefficient	SE	't' value	'p' value
	(Constant)	4.915			
1.	Age of the company	-0.106	0.072	-1.472	0.149^{NS}
2.	Educational qualification	0.086	0.058	1.489	0.144 ^{NS}
3.	Annual production (in tonnes)	-0.030	0.059	-0.507	0.615 ^{NS}
4.	Number of employees	-0.077	0.051	-1.520	0.136 ^{NS}
5.	Operating hours per week	-0.011	0.057	-0.185	0.854 ^{NS}
6.	Capacity of the Machine	0.021	0.075	0.285	0.777 ^{NS}
7.	Operating area of the mill	-0.016	0.065	-0.240	0.812 ^{NS}
	R Value	**0.905**			
	R^2 Value	**0.819**			
	F Value	**121.178***			

Note: * - Significant at 1% level; NS – Not Significant

The resulted equation is formulated as follows:

Level of perception towards energy conservation support from the government

= 4.915

- 0.106 (Age of the company)
+ 0.086 (Educational Qualification)
- 0.030 (Annual production in tonnes)
- 0.077 (Number of employees)
- 0.011 (Operating hours per week)

+ 0.021 (Capacity of the machine)
- 0.016 (Operating area of the mill)

The multiple linear regression co-efficient is found to be statistically fit as R^2 is 0.819 for level of perception towards energy conservation support from the government. It shows that the independent variables contribute about 81.9 percent of the variation in the level of perception towards energy conservation support from the government and this is statistically significant at 1% level. It is found from the analysis that the educational qualification and capacity of the machine are having positive association.

The resulted equation shows that level of perception towards energy conservation support from the government is predicted by the 0.106 unit decrease of age of the company, 0.086 unit increase of educational qualification, 0.030 unit decrease of annual production (in tones), 0.077 unit decrease of number of employees, 0.011 unit decrease of operating hours per week, 0.021 unit increase of capacity of the machine and 0.016 unit decrease of operating area of the mill.

Findings:

The major findings of the study are summarized as follows, they are

Profile of the Respondent:

- ✓ Majority (71%) of the mills are located in urban (Kangayam) area.
- ✓ Majority (47.5%) of the mills are at the age between 11 – 20 years i.e. started between 1997 and 2006, further 44% of the mills are at the age of below 10 years i.e. started after 2006. So 92% of the mills are started after 1997.
- ✓ Majority (68%) of the mills are come under the partnership firm.
- ✓ Majority (42.4%) of the key persons of the mills are having school level education alone.
- ✓ Majority (63%) of the mills are producing 2000-2500 tonnes annually.
- ✓ Majority (58%) of the mills are employed only up to 20 workers.
- ✓ Majority (51%) of the mills are working up to 48 hours per week.
- ✓ Majority (53%) of the mills are consuming below 50 000 units (kWh) annually.
- ✓ Majority (47.5%) of the mills are using 30 HP machines for production purposes.
- ✓ Majority (63%) of the mills are spending below Rs.3 50 000 for electricity expenses.
- ✓ Majority (56%) of the mills are operated on below 10 000 sq.ft.

Henry Garrett Ranking Technique:

- ✓ Necessity to Conserve Electrical Energy: 'Reduce electricity bill' took the first place which has the mean score of 67.7 followed by help the world to meet energy requirement, avoid global warming, save natural resources for future, reduce emission of green house gases and reduce pollution which has the least mean score of 38.7.
- ✓ Obstacles Faced in Installing Energy Conservation Technique: Higher cost and non availability of certified energy efficient products ranked I and II respectively according to Henry Garrett Ranking Technique. Lack of skilled labour and technical know-how in installation of technique were positioned in 3rd and 4th place respectively.
- ✓ Reasons for Not Using the Energy Saving Appliances: High cost of appliances ranked I followed by Less availability of products. Further, Short span of life and Less awareness ranked III and IV respectively.
- ✓ Expectation of Assistance from the Government: The most of the mill owners are primarily expecting subsidized rate for efficient product. They gave the second

place for getting subsidy in establishing alternate sources of energy. Thirdly, they want discount in EB bill while using energy efficient equipment. Finally, they expect awareness programme from the government officials and effective training to the employee at free of cost.

Anova Analysis:

All the respondents are having equal perception towards energy conservation support from the government irrespective of the age of the mill, educational qualification of the key persons of the mills, level of annual production, number of operating hour, capacity of the machine and operating area of the mills. But, the perception towards energy conservation support from the government and the number of employees differs in which the selected mills are not getting equal perception.

Correlation Analysis:

In correlation analysis, the perception towards energy conservation support from the government and educational qualification, operating hours per week, capacity of the machine and operating area of the mill are positively associated where as age of the company, annual production and number of employees are negatively associated with their level of perception.

Multiple Regression Analysis:

Multiple regression analysis confirmed the results of correlation analysis where the coefficient value of age of the company, annual production and number of employees are negative. Coefficient value of operating hours per week and operating area of the mill are also negative but the values are meager i.e. -0.011 and -0.16. Educational qualification and capacity of the machine are positively associated with the perception towards energy conservation support from the government.

Suggesstions:

- ✓ Mill owners are in need of awareness programme about the environment pollution and need protection of natural resources as most of the respondent worried about their electricity bills alone.
- ✓ The government can support the mill owners in the form of concessional price for the energy efficient products and discount in EB bill while using those products. This will encourage them in using the energy efficient product which will save the electric power.

Conclusion:

Electrical power constitutes one of the basic infrastructures for the social and economic development of a country. In India, about 45 percent of the energy sources are used for the generation of electric power. Energy supply is now not considered a commodity but a service. It is essential, therefore its use be in a rational way. Electricity is very flexible in the ways it can be used.

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