

# Applications and Primary Economics of PKL Power-A Case Study

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## Abstract

*Electricity from Pather Kuchi Leaf (PKL) is the new innovation in the world. It has been innovated in Bangladesh. So that Bangladesh perspectives it has a great impact in our society. Now a days, electricity is becoming an essential part of the life. It cannot keep running even a mobile and telephone without electricity, although it needs a very low amount of electricity to charge those things. In our country a few people are getting grid electricity. There are a large number of people in large part of the country like coastal areas, hilly areas, small islands, remote areas do not get grid electricity. The production of electricity from PKL is so easy. It can be operated by any one even an illiterate people and a handy capped people of the country. It is simple and affordable by all. Its need no advance knowledge on production of electricity. People can use this lantern easily instead of Karocin lantern. To disseminate among the people and also to make awareness among the people about the production of electricity from Pather Kuchi Leaf (PKL) some campaigns were conducted by the authors. During participation in some fair some questions were distributed to the people to take their opinion regarding PKL power to make it viable and feasible. Most of the results have been tabulated and graphically discussed.*

**Keywords:** PKL electricity, Applications, Public desire, Primary economics

## I. INTRODUCTION

The performance of cell is an important issue. There are some parameters through which we can measure the performance of the cell or battery [1-5]. A brief outlines of key parameters used to characterize a cell or battery are discussed earlier[24]. Also it is shown that how these parameters may vary with the operating conditions. The usability of any new technology not only technical based; but public acceptability is also very much important. Therefore, to know about the public desire about PKL electricity we undergo a small survey prepared by some questions [6-9]. The main objective of this survey was to know the willingness to use this technology, to study the duration of the PKL electricity at night and to find the expected primary cost for the PKL power system. To collect the information, a questionnaire was prepared to conduct a survey. Total 100 numbers of people were under this survey. The format of the questionnaire is attached in Appendix-A. In questionnaire total ten questions were prepared. The information and data collected through questionnaire is summarized in this paper.

Energy is the most important element in the society. We can not imagine the civilization without electricity. Now a days electricity need everywhere, even in the deep forest. It needs from space to deep see. The need of electricity is increasing day be day. As the new technology invented new demand for electricity is creating. Now electricity is needed not only for lighting to run the factory or industry but its use is everywhere. We are using electricity to run our computer, mobile telephone, various household appliances, toys etc. Everywhere we need electricity [10-15]. Therefore the present global trend is to increase the production of electricity. All over the world the production of electricity is basically depends on non-renewable sources mainly oil, gas and coal. These all are natural resources and not unlimited. The total reserve of these resources is fixed. So it is a great concern what will happen after finishing of these resources. A lot of researches are going to find alternate solution for production of electricity. Now we are using solar energy, wind energy, tidal energy, biogas energy, hydro power, wave energy, OTEC (Ocean Thermal Energy Conversion) etc. These all are the alternative sources of energy and definitely renewable energy. These sources will never run Out. All over the world has emphasis on these renewable resources for its improvement. Generation of electricity from Pather Kuchi Leaf (*Briophyllum Pinnatum*) is an addition in the list of renewable energy [11-16]. It is invented in Bangladesh and it has great

advantages over other renewable resources. For an example in case of solar energy is not possible to produce electricity during night, in case of wind energy wind must be blow for the production of electricity, in case of tidal energy, wave energy, hydro energy it needs specific requirement. But for the production of electricity from Pathor Kuchi Leaf it is free from these drawbacks. We can produce it anywhere, anytime, any places without going any complexity. Not only that this technology is so easy to make it possible to make and use it without any previous technical knowledge[17-20]. Moreover it provides electricity directly from the system which is very convenient easy and cheap. Bangladesh is a developing country. For the proper development of the country supply of electricity is a must. But we have a great shortage of electricity. This shortage of electricity is creating a great barrier in our development. Most of the people in Bangladesh live in rural areas and majority of them are poor. So, to reduce poverty of that majority part of the country it is important to provide energy to them. The rural people of Bangladesh are facing poverty because they are using very little energy in an inefficient way. This is a great challenge of the government of Bangladesh to meet the future demand of electricity in rural areas. Production of electricity from Pathor Kuchi Leaf can be a means for providing electricity to the villagers. Pathor Kuchi tree grows everywhere in Bangladesh [31-36]. Even it grows in the corner of our yard, in free land even in the road side. We can use the leaf of this tree to produce electricity. We can produce juice of the leaf and can preserve long time without any special arrangement for long time. So it is very much convenient to produce electricity using the juice of the leaf. Even we can use this electricity to light up our boat on the river at night or charge our valuable mobile device for communication at the remote areas [21].

**II. Methodology**

**II A. (i) Name and address**

The first question of the questionnaire made by the authors was the name and address of the interviewee. It was just to identify the interviewee.

**(ii) Age Group:**

The second question of the questionnaire was the age of the interviewee. For the sake of simplicity it was divided the interviewee’s age in 5 groups. These are: (i)20-30 years, (ii)30-40 years, (iii)40-50 years, (iv)50-60 years and (v)More than 60 years. The age groups of various interviewees are shown in tabular form in table-1.

Table-1: Age group of respondents

Sl. No.	Age Group	Responded
1	20-30 years	67
2	30-40 years	7
3	40-50 years	10
4	50-60 years	13
5	More than 60 years	3
	Total =	100

It may be pointed out here although we collected information from all the age groups but we emphasized on younger group during data collection. Because, this group will be the potential users of this technology in immediate future [22]. The age group and the number of responded are shown graphically in Fig.1.

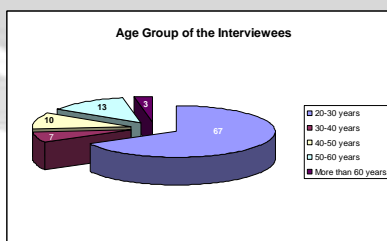


Fig.1: Age group of the interviewees

**(iii) Means of lighting at night**

There are many places in Bangladesh where there is no grid electricity. They usually use of Karocin for lighting at night. Some reasons of using karocin are as no grid electricity is in that areas for easy to get and easy to use. Since, Karocin is easy to get and easy to use, people are using Karocin year after year. But, Karocin provides not only insufficient light but also pollutant environment. Now a days people are also using solar panel, bio-gas plant and also generators for their electricity generation. Solar panel is expensive. Initial investment is high. So only the rich people can achieve this plant. Bio-gas plants relatively low initial investment. But it needs a lot of space as well as supply of daily raw material. Generator is other alternative of getting electricity [23-29]. Although for a single family the initial cost is not so high now a days but it needs a big running cost. To keep it

in mind, the question in questionnaire survey regarding the use of means of getting light at night to our interviewee. The answers we got are summarized in table-2.

Table-2: Means of lighting at night

Sl No.	Means of lighting at night	Responded
1	Karocin	10
2	Generator	4
3	Solar panel	12
4	Biogas plant	3
5	Others	71
	Total	100

The results of responses are shown graphically in Fig.2.

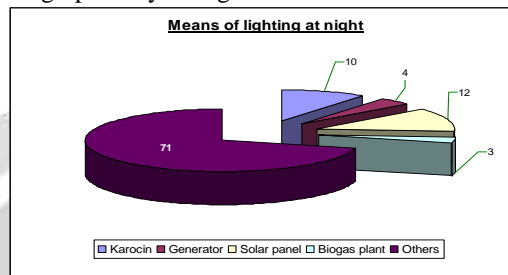


Fig.2: Means of lighting at night

**(iv) Hours of lighting needed at night for prototype PKL power system**

It is known that the people needs lighting after evening. The lighting required for various purposes and it depends on the person’s nature and profession. For example, for student it needs longer time at night to study but for a farmer it needs less time illumination at night. So our next question was “How many hours do you need to use light at night?”. For the simplicity of the interviewee we seek the answer in five slots. These are: (i)1-2 Hours, (ii)3 Hours, (iii)4 Hours, (iv)5 Hours and (v)More than 5 hours. The response found as summarized in table-3.

Table-3: Hours of lighting needed at night.

Sl. No.	Light uses at night	Responded
1	1-2 Hours	1
2	3 Hours	18
3	4 Hours	12
4	5 Hours	15
5	More than 5 hours	64
	Total	100

The results of responses are shown graphically in Fig.3.

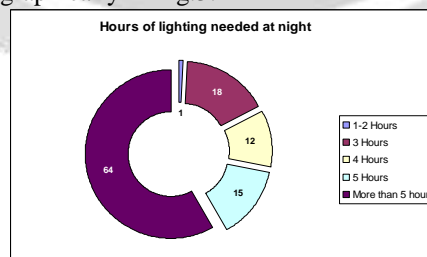


Fig.3: Hours of lighting needed at night.

At present the use of electricity from PKL can not support heavy load for longer time for prototype system. If someone needs this type of load electricity from PKL may not be suitable for his/her demand at the present stage of prototype system. But for lighter load it may fit his / her requirement for prototype system.

**(v): Cost for lighting per month at night**

Our fifth question was related with cost per month for lighting at night. We know various people have various ways for lighting at night. Therefore, the cost will not be the same for all users. Our intension was to find the cost to compare with the cost of PKL system. To make the answer convenient we made group the costing in five

categories. There are: (0 –300 Tk.), (300 –500 Tk.), (500– 800 Tk.), (800–1000 Tk.) and More than 1000 Tk. The responses found are summarizing in table-4.

Table-4: Cost for lighting per month at night.

Sl. No.	Cost per month (Tk.)	Responded
1	0 – 300	9
2	300 – 500	37
3	500 – 800	21
4	800 – 1000	15
5	More than 1000	18
	Total	100

The results of responses are shown graphically in Fig.4.

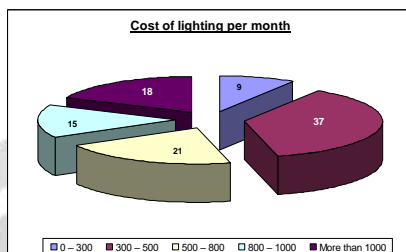


Figure-4: Cost for lighting per month.

In PKL electric system initial cost is the ultimate cost. In this system, no need to think about monthly bill or monthly costing. People needs to take care of the system like changing the PKL juice and cleaning the electrodes periodically [30-32].

**(vi): Interest of using PKL electricity system**

Next three questions were yes / no question. The intension was to find about the peoples’ feeling and interest about PKL electricity system. The questions were: (i) Do you know about Pathor Kuchi Leaf ? (ii) Do you know electricity can produce from Pathor Kuchi Leaf (iii) If it is cost effective and easy to produce are you interested to use it?. The respondes found are summarizing in table-5.

Table-5: Feeling and interested of Pathor Kuchi Leaf (PKL) electricity system.

Base of response	Yes	Number
Know the PKL	91	9
Know PKL can produce electricity	76	24
Interested to use PKL electricity system	98	2

The results of responses are shown graphically in Fig.5.

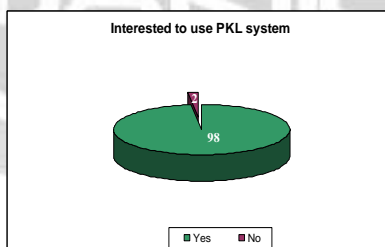


Fig.5: Interested to use PKL system.

From the responses, it is seen that people are highly interested to use the PKL system. Only two responded were negative. The reasons are: It is not a modern technology and the availability of Pathor Kuchi Leaf is a scarce. So, the survey provided the result that the people are very much interested to use this technology.

**(vii): Expected cost for a two lamps PKL electricity system**

To make a new system cost is a vital issue. If the cost is higher then the system may not be affordable by the general people. So, our last question was to know the expected cost for a two lamp system. We asked for a two lamp system considering the least requirement of a small family. For simplicity of the interviewee we seek the answer in four slots. These are : (i) Within Tk. 300 (ii) Within Tk. 500 (iii) Within Tk. 1000 and (iv) More than Tk.1000 Tk. The responses found are summarizing in table-6.

Table-6: Expected cost for a two lamps PKL electricity system.

Sl. No.	Expected cost (Tk.)	Responded
1	Within Tk. 300	76
2	Within Tk. 500	18
3	Within Tk. 1000	5
5	More than Tk. 1000	1
	Total	100

The results of responses are shown graphically in Fig.6.

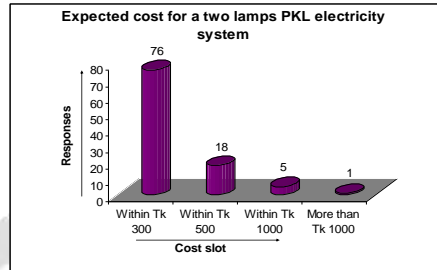


Fig.6: Expected cost for two lamps PKL system.

The cost for a two lamp system will actually very depending on the hours of use. If the hour of use is less, cost will also be less. If we consider a two lamp PKL electric system with for 2 hours lighting the approximate cost of the system as shown in Fig.6 which will be around 600 Tk. It is not so expensive compared to other systems [33]. But it is higher as expected by the potential user.

**II B. Distribution of PKL power System**

As a first step of awareness campaign we distributed two PKL systems to the two poor street side shop owners in the capital Dhaka city. One in a tea stalls other in a shoe repairing shop. Following pictures show the photograph of them.



Fig.7: Use of PKL electricity at a tea stall at Shantinagar, Dhaka, Bangladesh.



Fig.8: Use of PKL electricity at a street side shoe repairing shop at Santinagar, Dhaka, Bangladesh.

Both the shop keepers were happy to get this new electricity. We take the above photograph from the shop just after evening and it was producing sufficient electricity for their small shop [34]. People are now using PKL electricity for their own use in some areas specially remote areas. A photograph in Fig.9 shows the children are studying at night and some other practical applications with the PKL electricity in a remote village of Magura District and at the city areas of Bangladesh respectively.

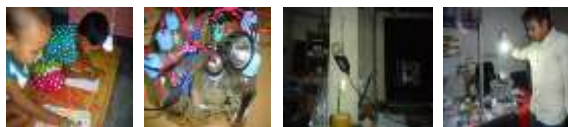




Fig.9: Some Applications of PKL power

### HC: Participation on Fair

Additionally we participated in a fair named “Anando Mela” arranged at 26 Baily Road in their premises by Officers club, Dhaka in December, 2012. The main objective of that participation was to inform the people and disseminate the technology among the people. We also gather knowledge about the performance parameters they are interested. Two photograph of that fair are shown in Fig.10. This demonstration was made by the authors. This exhibition provided us some beautiful idea and attraction of the users about PKL electricity.



Fig.10: Participation in the fair at the premises of Officers Club, Dhaka.

Additionally we provided a backup support to a group of school boys who were interested about the production of electricity from PKL and wanted to participate in the Inter School Science Competition held at Ideal School and College, Motijheel, Dhaka, Bangladesh on June/2013 organized by Ideal Science & Technology Aiming Research Council. The main objectives of this support were: (i)To disseminate the knowledge of producing electricity from PKL to the younger and (ii)To make this technology interesting among the people. Two photographs of that competition are shown in Fig.11.



Fig.11:Participation in the Inter School Science Competition at Ideal School and College, Motijheel, Dhaka, Bangladesh.

### III. Further Study

The age of invention of generating electricity using Pathor Kuchi Leaf (PKL) is new. It is completely new invention. In this system we can access the electricity with the easily available PKL. But since the new invention it needs a lot of research. In this study it is focused almost all the parameters related with the system. Although some parameter is really very shown the bright future of the technology but some parameters need deep research. So that this new technology needs to identify the SWOT analysis. Following are some of the points for future study to reduce the internal resistance, to increase the voltage regulation, to produce more power in more convenient way, to analyze the contents of the PKL juice, to optimize on concentration of the PKL juice for better results, to minimize the polarization effect, to save the Zn plate from erosion, to Study the complete reaction on the PKL cell, to Study on anodic and cathodic plates of the PKL cell and also to Study and construction the best placement of the electrodes in PKL cell[35].

### IV: Applications of NPs (produced from PKL extract) for better performance.



Fig.12: Practical Applications of NPs from PKL extract

For better performance in our practical application, it was used zinc and copper plate as electrode and manganese dioxide Nanoparticles (NPs) as a catalytic agent and water was used as solvent with PKL extract. It is successfully proved that only 2-2.5 grams of manganese dioxide Nanoparticles (NPs) can generate 12 watt DC led bulb which is shown in Fig.12.

#### **V: Recommendations:**

It is now in such a time where the demand of electricity is increasing day by day whereas the production of electricity from conventional sources is reaching in an alarming situation in Bangladesh. The whole world is now thinking about to shift from conventional energy sources to non conventional energy sources. Also the people are awaking day by day against conventional sources. Therefore, electricity generation from PKL is an important invention for mankind. Electricity from Pathor Kuchi Leaf (PKL) is one of the non conventional sources of energy. It is possible to produce and use the electricity directly from this method. The production of electricity from this system is very simple and easy. It grows easily without any care and made the system ourselves. Since it is a new invention, it still needs a lot of R&D work for its improvement. Now, at this stage this is suitable for low power application such as low power lighting at night in rural areas. For the improvement of PKL electric system most emphasis should be given to reduce the value of internal resistance. The high value of internal resistance creating the high value of the voltage regulation and reducing the power output from the system. It is known that every renewable energy system has some limitation. The electricity generation from PKL leaf is not beyond those limitations. If it can reduce the value of internal resistance of the system it may be a very suitable source of renewable energy.

#### **VI: Conclusions**

Usability of a new invention is very much important. If there is no usability the technology is in vain. To determine the usability it is very much important to measure its performance. So the performance analysis is very much important. Under this study it is tried to identify the performance parameters of the PKL electricity system. Since the production of electricity from PKL is relatively new invention therefore the measurement of its performance is a vital thing. For the measurement of performance, performance indications are most important issue. As new invention performance indicators of PKL electricity system is not yet determined. In this study it is tried to indicate the performance comparing the cell and battery performance. In this study following performances were performed: Discharge characteristics, Temperature characteristics, Self discharge characteristics, Equivalent circuit and internal resistance, Effects of internal resistance, Discharge Rates and Peukert's law, Pulse Performance, Cycle Life and Deep Discharge, Voltage Regulation, Capacity determination of PKL system, Efficiency calculation of PKL system, Willingness of the people to use the technology and Expected cost for the system. From the above parameters, except the internal resistance and voltage regulation, all other parameters are satisfactory comparing with the performance indicators of the cell and battery. We got the typical value of internal resistance is  $0.6 \Omega$  which was very much higher than the acceptable range. Since the internal resistance in turns liable for internal voltage drop therefore the voltage regulation we found was also poor. We found the typical voltage regulation around 12%. After doing R&D work, it has been reached suitable values. One of the important sides of this study is to determine the efficiency of PKL power system. In case of conventional battery, efficiency is determined with the ratio of discharging power to the charging power [35-37]. Since in PKL system we need not any charging therefore we determine the efficiency with the conventional efficiency formula output to input, determining the total internal loss.  $MnO_2$  NPs were successfully synthesized through leaf extract mediated photosynthesis process using potassium permanganate as a precursor and *Bryophyllum pinnatum* leaf extract as a reducing, capping, and stabilizing agents' provider for sustainable electricity production.

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