2019 IEEE Region 10 Humanitarian Technology Conference
Depok, Indonesia | November 12-14, 2019

Sharing Light and Knowledge to Underdeveloped Village with Portable House Lighting System

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***Abstract*— The province of Banten on western end of Java is one of the provinces with most visible disparity in the area development, in the southern part, the terrain is mountainous with dry valleys, this condition led to being the poverty area. The *Cahaya Kebudiluhuran* or "Noble Light" Project aims to implement the ideals of intelligent and noble humanity through the use of technology for the benefit on the greater community. The main target community is the Menes village in Pandeglang Regency, among the poorest region in otherwise flourishing Java's other regions. The first phase of Noble Light Project implementation consists of distributing and installation of forty battery-operated portable home lighting equipment for 40 houses, and one battery charging station located at the Village Office Hall. The Portable House Lighting Unit consists of a 12 V, 45 Ah battery, 1.5 W LED lights and regulator/ control panel capable of 67.5 hour life cycle. Laboratory test for the unit performance shows that for normal 11-hours night-time use from 6 PM to 5 AM the house unit can provide lighting for 5 to 6 days.**

Keywords—community, humanity, portable lighting, education, knowledge sharing

I. INTRODUCTION

Although relatively modern and the most developed part of Indonesia, Java island still has some areas untouched by the rapid development spread from major cities and industrial and commercial centers. This development led to more and more people from rural areas to flock into major population centers, which in turn causes the rural areas to gradually put in lower priority for development. The province of Banten on western end of Java is one of the provinces with most visible disparity in the area development, whereas the northern part is marked with broad plains dotted with industrial centers such as Tangerang, Serang (the province capital), and Cilegon. On the southern part, the terrain is mountainous with dry valleys, this condition led to being the poverty area.

Universitas Budi Luhur is a private university with its mission to spread knowledge to the community, one of the project to alleviate poverty is Green Kamal Project in Jakarta Barat city [1]. Taken place from 2015 to 2018, the project improves the sanitation and lighting condition of a coastal village being isolated by the development of international airport with its associated toll road. Aside from providing lighting for the community, the installation also used to explore the possibility and feasibility of portable photovoltaic power generator [2], and the basis for studying Maximum Power Point Tracking of a photovoltaic panel and its performance [3, 4]. Since electrification access in Indonesia only covers 53.4% nationwide [5], there are still much more to be covered by electrification program. However, rural electrification is a dynamic development process [6], such as developing the energy infrastructure to sustain energy needs, therefore, many types of basic electricity equipment (i.e. lighting) can be developed [7,8] to give benefit to the receiving community [9].

II. PROJECT OBJECTIVE

The project launched by Universitas Budi Luhur is named *Cahaya Kebudiluhuran* or "Noble Light", which aims to implement the ideals of intelligent and noble humanity through the use of technology for the benefit on the greater community. This project is a continuation from the previous Green Kamal Project undertaken in Jakarta [1], which aims to increase the reach of Universitas Budi Luhur impact and influence on the communities in Indonesia.

III. OVERVIEW OF THE TARGET COMMUNITY IN PANDEGLANG

The main target community of *Cahaya Kebudiluhuran* (Noble Light) is the Menes village in Pandeglang Regency, at Banten, the westernmost province of Java. The Pandeglang Regency consists of the mountainous mid-southern part of Banten Province, where the climate is relatively dry compared to the other part of Java with annual rainfall of only 13mm/year. This condition led to the regency, along with neighboring Lebak Regency to become among the poorest region in otherwise flourishing Java's other regions.

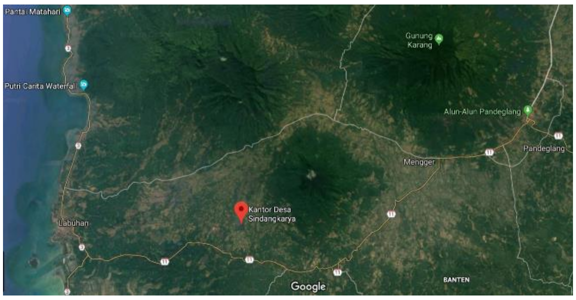


Fig. 1. Pandeglang area with dry valleys shown between the mountains, Menes Village is between the three mountains (Image source: Google Maps)

Situated on a valley between three mountains (Fig. 1), the Menes Village was originally a Portuguese trading outpost with a warehouse (*mones*) for produces from local villages. As of 2018, the population is only 6200 lives in 1590 households. These families living in 1244 houses built on 8 hectares of inhabited land, with the remaining 300 hectares are dry farmland, of which, only 158 hectares are arable land.

Demographically, the village population consists of 3189 males and 3026 females, of which 3937 are children and teenagers. Total workforce with permanent jobs are only 1675 persons.

(a)

(b)

Fig. 2. One of Menes village house condition: (a) external condition, (b) interior and owner

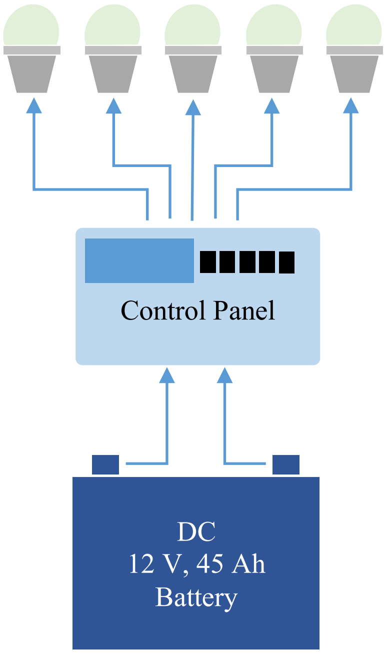
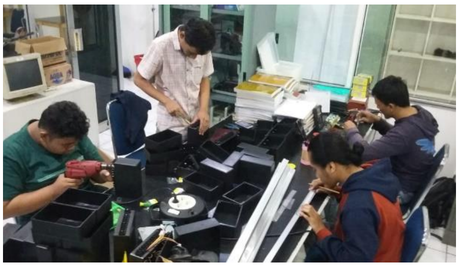


Fig. 3. Portable House Lighting Sistem Unit's diagram

Poor economic conditions means that less than half of the houses are permanent built houses, and electricity access is only for over two-thirds (900 units) of the houses with highly subsidized supply from the government through PLN (the state electricity company) Village Electrification Program. Fig. 2 shows one of the *Cahaya Kebudiluhuran* recipient candidate residences' house during preliminary survey, classified as semi-permanent building by the provincial government, it is a 30 m^2 earth-floored, bamboo thach weave-walled house with two bedrooms and kitchen.

IV. Project Implementation: Phase 1

The first phase of Noble Light Project implementation consists of distributing and installation of forty battery-operated portable home lighting equipment for 40 houses, and one battery charging station located at the Village Office Hall. The number 40 represents the 40th anniversary of Universitas Budi Luhur since its foundation as a Computer Science Academy in 1979.



(a)

(b)

(c)

Fig. 4. Assembling the portable home lighting system at Teknik Elektro Laboratory – Universitas Budi Luhur: (a) control panel, lighting and wiring assembly, (b) completed Portable House Lighting Unit without battery, and (c) testing of the Portable House Lighting Unit

A. *Noble Light Equipment*

Similar to the Village Lighting System (VLS) by Gajic and Greenwood [7], the house installation is assembled in-house by the Department of Electrical Engineering as shown in Fig. 3a-c, it consists of a 12 V, 45 Ah battery, 1.5 W LED lights and regulator/control panel. The house lighting unit diagram is depicted in Fig. 4. Theoretically, each unit is capable of

Cahaya Kebudiluuran is funded by Yayasan Pendidikan Budi Luhur Çakti

supplying 540 Watt-hour, and the component (LED and regulator) consumes a total of 8 Watts, which translates to 67.5 hour life cycle. Laboratory test for the unit performance shows that for normal 11-hours night-time use from 6 PM to 5 AM the house unit can provide lighting for 5 to 6 days.

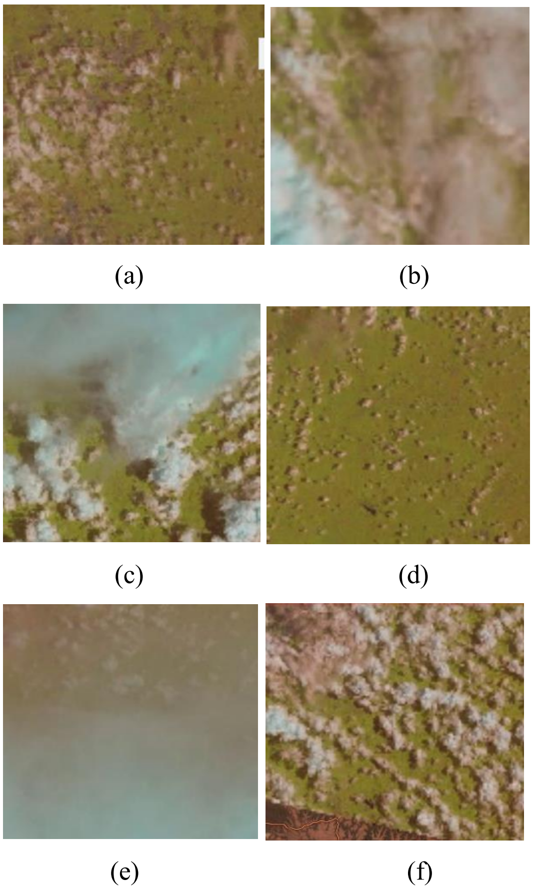


Fig. 5. Landsat 8 imagery of Pandeglang in January (a-b), February (c-d), and March (e-f) 2019 taken from USGS Earth Explorer showing high percentage of cloud coverage

The Battery Charging Station Unit is planned to be a PV-based charging station, but due to the village's location, there are not enough daily sunlight because of frequent dense clouds coverage trapped between the mountains (Fig. 5). Therefore, for the first phase the charging station uses gas-operated power generating unit of 3,8 kVA capacity capable of charging four batteries simultaneously (Fig. 6).

B. *Survey, Installation, and Education*

Initial survey and outreach for Noble Light Project commenced on February 2019, started with presentation on the project to village and district officials, and then to the village residents, mainly to local housewives members of *PKK Group* (family welfare association) as can be seen in Fig.7. From discussion with PKK, they nominate 50 candidate households for Noble Light recipients. Site verification is performed by faculty members along with students doing field work at the village. The criterion for eligibility is that the houseis not connected to existing electricity grid network, not a multi-storey building. After careful consideration, there are 40 households that eligible as Noble Light recipient.

Since most recipient households are not familiar with electricity and its associated house wiring, therefore a necessary training course on operation and maintenance of the house lighting unit is initiated before house installation started. Although the house lighting unit is designed to be easily and safely operated by the village residents, education on electrical safety aimed to ensure that the house lighting system can be used to its optimum capability and to prevent mistakes during operation and maintenance by the residents. Training takes place from February to March 2019 by Universitas Budi Luhur faculty members and students undergoing Community Work Course program as can be seen in Fig. 8.

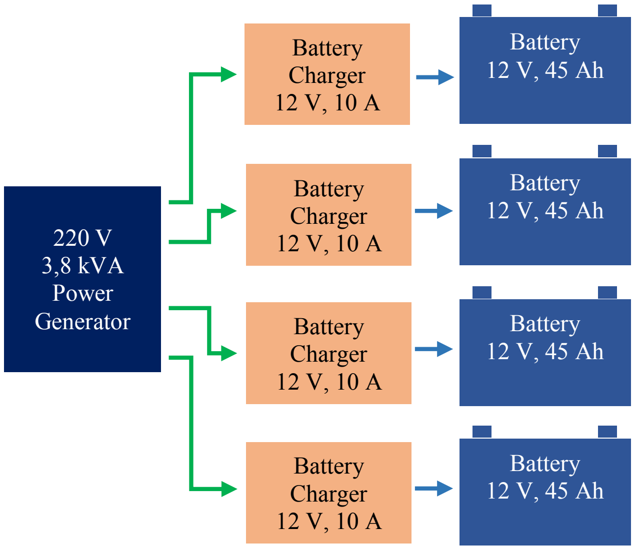


Fig. 6. Charging Station Unit

Fig 7. *Cahaya Kebudiluhuran* Team initial meeting with residents

Fig. 8. Training on *Cahaya Kebudiluhuran* portable house lighting unit installation, operation, and maintenance

Installation of the charging station completed on 4 Maret 2019 performed by Universitas Budi Luhur faculty members at Menes Village Hall, while house units installations are done by Universitas Budi Luhur students in March 2019 and the first phase of the project finally inaugurated on April 2019.

On-site testing from actual usage by recipient households with 12-hours operation of all five attached 0.25A/9V lamps yields 27Wh consumption rate. With 35A/12V battery, which translates to 420W, the portable unit could use 70% of the battery capacity in 11 days, while minimum usage of single lamp yields 15Wh and the battery could last for 20 days before recharging. Further testing and measurements are still ongoing to determine the reliability of the equipment and calculating the carbon footprint of the charging station for future compliance with low carbon society before transitioning to other renewable energy [10].

V. Conclusions

The *Cahaya Kebudiluhuran* Project takes place from February to April 2019, where 40 units of portable house lighting system and one charging station has been deployed. This activity also accompanied by educating village residents on how to instal, operate, and maintain house electrical equipment safely.

Field testing reveal that the portable house lighting system could provide lighting between 11 to 20 days before the battery needs to be recharged. Future works is expected to provide hybrid charging station and more detailed equipment performance measurement, including carbon saving.

Acknowledgment

The authors of this paper would like to thank Drs. Djaetun HS for initiating *Cahaya Kebudiluhuran* Project, and Mr. Kasih Hanggoro of *Yayasan Pendidikan Budi Luhur Çakti* for his support on the project.

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