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# Assessing implementation of low-carbon technologies in Thekelan Hamlet, Indonesia using participatory rural appraisal method

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## Abstract

Thekelan hamlet is located at the foot of Mount Merbabu makes the electricity that reaches this village experience a reasonably high loss percentage. By utilizing the sunlight, the community can make a power plant with solar cell technology . In addition, the majority of residents in Thekelan Hamlet still use wood-fired stoves for cooking. This condition is, of course, not environmentally

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# Preface

The International Conference on Environmental and Sustainability Context (ICoESCo) 2021 is the first international conference hosted by Environmental Sustainability Research Group (EnSi-RG) and co-hosted by Environmental Research Center, Lembaga Penelitian Universitas Trisakti, Environmental Engineering Department, Faculty of Engineering, Universitas Diponegoro, and Kitakyushu Indonesian Students' Union. This conference was successfully held on August 24, 2021 which brings the theme of "Emerging Challenges and Opportunities for Achieving Environmental Sustainability" since the theme of "*sustainability*" has become the most crucial issue of the world by now. This conference was attended by 81 participants that came from 34 universities across the world which include as follows.

1. Indonesian Universities and Institutions
    1) PT Sampoerna Agro Tbk
    2) Center for Advanced Material Science and Technology, Serpong,
    3) Universitas Diponegoro,
    4) Universitas Andalas,
    5) Universitas Islam Negeri Sunan Ampel Surabaya,
    6) Institut Pertanian Bogor,
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    19) Universitas Bina Nusantara,
    20) Bogor Agricultural University
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    22) Institut Teknologi Sepuluh Nopember,
    23) Institut Teknologi Nasional, and
    24) Institut Teknologi Pembangunan Surabaya.
2. Overseas universities
    1) Ndejje University – Uganda,
    2) International University of East Africa – Uganda,
    3) RWTH Aachen University – Germany,
    4) Mardoch University – Australia,
    5) Hochschule Ruhr West – Germany,

6) The University of Haripur – Pakistan,
7) Hydro-Quebec Institute of Research - Canada,
8) Universiti Tun Hussein Onn Malaysia - Malaysia
9) Helmholtz Centre for Environmental Research – Germany, and
10) The University of Kitakyushu – Japan.

The discussions cover some upcoming topics such as solid waste management and treatment, water and wastewater recycling, climate change and global warming, environmental management and economic, renewable energy, environmental health and risk, environmental education, nanotechnology and artificial intelligence and big data for environment.

Since the number of COVID-19 cases in Indonesia is still high in July – August 2021, the committee decided to hold the conference in a virtual setting. The committee used the Zoom Application to ensure the delivery of the research material could be done smoothly. The meeting is part of the annual meeting of the scientific consortium initiated by the Environmental Sustainability Research Group. Because of the importance of this meeting, the committee should conduct this conference even in a virtual situation. The invited keynote speakers all are as follows: Dr. M.V. Reddy (Hydro-Quebec Institute of Research, Canada); Dr. Astri Rinanti Nugroho, M.T. (Universitas Trisakti, Indonesia); Dr. Kamran Azam (The University of Haripur, Pakistan) and Prof. Hiroyuki Miyake (The University of Kitakyushu, Japan) who is divided into 2 plenary sessions. The speakers talked for 25 minutes and continued with 15 minutes of discussion. The committee used the breakout room function of the Zoom Application for facilitating an actual conference situation. The detailed of plenary, parallel, discussion, question, and answers sessiom are posted in the website https://www.icoesco.site/. There are 4 breakout rooms where 11-12 presenters were delivering their research results. The presenter has 10 minutes to present and 5 minutes to ask some questions from the audiences. All of the participants were allowed to join the rooms they wanted to. Even in a pandemic situation and done online, this conference is expected to give an interactive forum for sharing and exchanging knowledge on the latest and potential research collaboration in environmental science, engineering, education, and health. There are several scientific manuscripts produced through this conference which most of them are sent to the IOP Conference Series: Earth and Environmental Science for further process. The paper consists of the broad topic of environmental management, engineering, and science. All of the manuscripts are peer-reviewed by the expertise coming from the different scientific research fields.

The committee wants to thank all of the participants coming to this conference. The committee also wants to express the deepest gratitude to the keynote speakers, reviewers, and moderators who contribute to this conference's success. The committee also wants to acknowledge IOPP for publishing our conference proceedings. It is hoped that the readers can feel and extract the knowledge and get some memorable experience and information during the exploration of our scientific manuscript. The committee also wants to apologize for all of the mistakes found in the conference and the published papers.

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ICOESCO 2021 Committees

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24th August 2021

Virtual Conference

Semarang-Indonesia

REGISTRATION

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The International Conference on Environmental and Sustainability Context (ICoESCo) is the first international conference hosted by Environmental Sustainability Research Group (EnSi-RG) and co-hosted by Environmental Research Center, Lembaga Penelitian Universitas Trisakti, Environmental Engineering Diponegoro University and Kitakyushu Indonesian Students' Union. The conference will bring the theme of **"Emerging Challenges and Opportunities for Achieving Environmental Sustainability"**.

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2. Water and Wastewater Recycling
3. Climate Change and Global Warming
4. Environmental Management and Economic
5. Renewable Energy
6. Environmental Health and Risk
7. Environmental Education
8. Artificial Intelligence and Big Data for Environment
9. Nanotechnology

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# Keynote Speakers

## Dr. M.V. Reddy

**(Hydro-Quebec Institute of Research, Canada)**
"Nanotechnology"
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## Dr. Astri Rinanti Nugroho, M.T.

**(Universitas Trisakti, Indonesia)**
"Renewable Energy"

## Dr. Kamran Azam

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"Environmental Sustainability"
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## Prof. Hiroyuki Miyake

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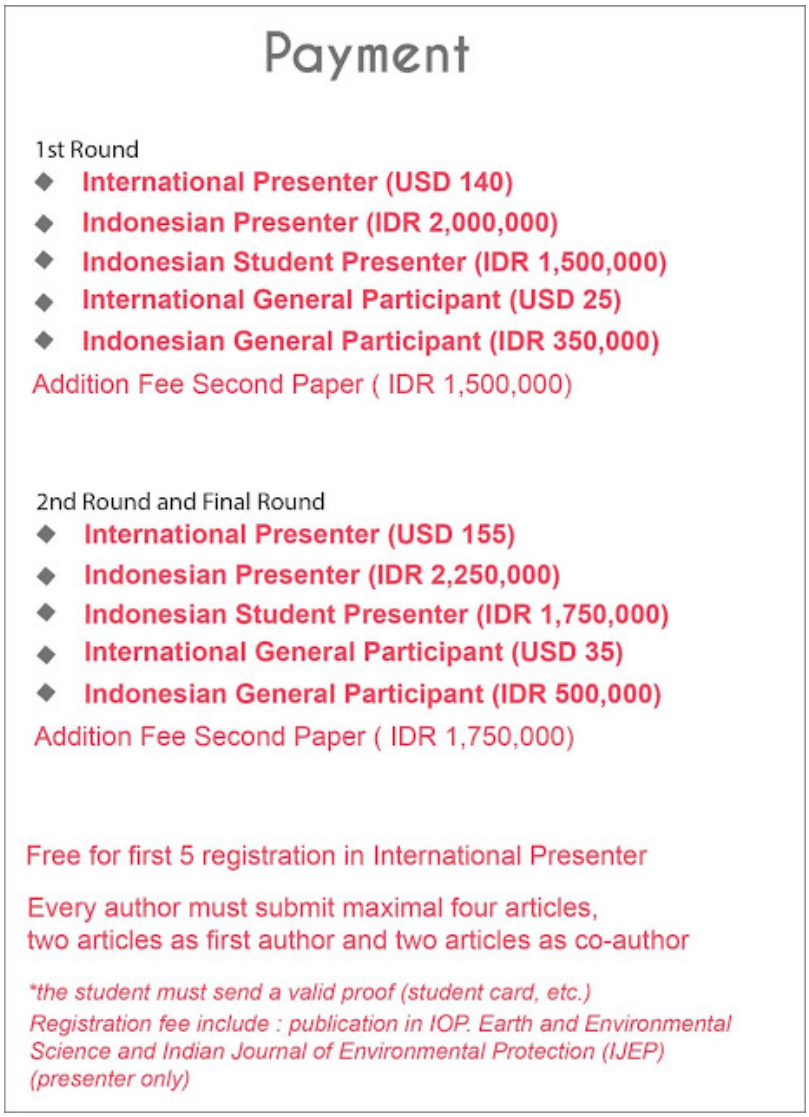


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# Assessing implementation of low-carbon technologies in Thekelan Hamlet, Indonesia using participatory rural appraisal method

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**Abstract.** Thekelan hamlet is located at the foot of Mount Merbabu makes the electricity that reaches this village experience a reasonably high loss percentage. By utilizing the sunlight, the community can make a power plant with solar cell technology. In addition, the majority of residents in Thekelan Hamlet still use wood-fired stoves for cooking. This condition is, of course, not environmentally friendly because the combustion releases high carbon into the atmosphere. Therefore, the prospect of renewable energy has not yet been fully exploited. This situation is due to the low level of knowledge, education, and capital owned by residents. The Participatory Rural Appraisal (PRA) approach were used to develop low-carbon society in Thekelan Hamlet. This approach comprises three stage including workshop, action, and reflection stage. Result shows that the community in Thekelan District were able to implement low-carbon society. However, the capital price of low-carbon technology such as solar cells and dew catcher is still high with respect to the output that they can generate. Therefore, the community is agree to contribute and join to the development of this program in the future since they realize that low-carbon society can induce economic development of the hamlet.

## 1. Introduction

Thekelan hamlet is an enclosed area or an area surrounded by the Mount Merbabu National Park area, which is located in Batur Village, Kopeng District, Semarang Regency. Mount Merbabu National Park is a conservation forest area of 5,725 hectares [1]. The number of residents living in Thekelan Hamlet is 280 families, with 720 residents employed in the livestock and agriculture sectors. They are active in the Mount Merbabu National Park area to take grass as a source of animal feed and firewood for cooking. The utilization is increasing in line with the community's increasing needs due to the low level of community income and the increase in population. The number of dairy cows in this village reaches 500 cows which the majority coming from Holstein Fresian breeds. Each house has an average of 3 cows, of which two of them are dairy cows [2,3].

Besides, Thekelan Hamlet has another energy potential that can be developed as a ecotourism spots through water energy and sunlight. There are also several small rivers as a source of water for irrigating the rice fields of the Thekelan Hamlet community and have the potential to be a location for the construction of micro-hydro turbines. Technically, the opportunity to build micro-hydro electricity

# Investigating the effect of PET plastic bottle strips on the strength and compressibility properties of clayey soil

**J B Niyomukiza[1,2*], A Bitekateko[1], J Nsemerirwe[1], B Kawiso[1] and M Kiwanuka[1,2]**

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**Abstract**. The production of plastic bottles by the manufacturing industry has increased drastically over the last six decades across the globe. This rapid production has led to the generation of many waste plastic bottles, thus causing environmental pollution. About 180 tonnes of plastics are generated daily in Kampala, the capital city of Uganda, and around 50% is dumped into the Kiteezi landfill. Instead of putting pressure on the landfill, these plastic bottle wastes could be reused in stabilizing soils with poor engineering properties. The current study investigates the engineering properties of clayey soil reinforced with Polyethylene-terephthalate waste plastic bottle strips. In order to achieve the objectives of the study, the geotechnical and engineering properties of the soil reinforced with waste plastic bottle strips at 0.1, 0.2, 0.3 and 0.4% of the dry unit weight of the soil and non-stabilized soil were determined by conducting laboratory tests, such as particle size distribution, Atterberg limits, compaction test and California Bearing Ratio. The results revealed that the California Bearing Ratio of the soil reinforced with Polyethylene-terephthalate waste plastic bottle strips increased with the increase in the percentage of Polyethylene-terephthalate waste plastic bottle strips up to 0.3%. Beyond 0.3%, a drop in California Bearing Ratio was observed. It indicates that 0.3% Polyethylene-terephthalate waste plastic bottle strips is the optimum percentage for stabilizing low plasticity clayey soils.

## 1. Introduction

Plastic waste management is becoming a significant challenge in developing countries like Uganda. Data from various sources reveal that out of 180 tons of plastics that are generated [1,2], 40-50% are transported and dumped to the Kiteezi landfill that is located in Kampala, Uganda [3]. It means that the rest of the waste plastic bottles are disposed in a manner that is not safe. Even those dumped on landfills increase pressure or are poorly managed, as shown in Figure 1 [1]. It is noted that since the population is increasing, the number of wastes generated will also keep on increasing. It calls for looking for alternative ways of utilizing plastic wastes in other sustainable ways. Among the ways of reusing waste plastics could be stabilizing soil. Different solid waste materials, like waste tyres, industrial wastes, incinerator ash, and others, have been used to stabilize soils with poor engineering properties, showing positive results [4–6]. The basic idea about soil stabilization is about improving or altering the index properties, improving the gradation, and improving the soil's strength properties to be suitable for

# New species *Pseudomonas capeferrum* TDA1 as a plastic monomer utilizer and a PHA native producer

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**Abstract**. Over the decades, global plastic production has been exponentially increasing with a significant increase of plastic waste as well. Consequently, our environment has suffered a lot because synthetic plastic is less biodegradable or even not completely biodegradable. On the other hand, the conventional recycling rate and plastic management in the top ten plastic contributors are still low to reduce the contamination and pollution from plastic waste. Particularly, Indonesia, one of the world's most outstanding emerging market economies and has the most contribution on plastic waste in ASEAN, should consider breakthrough and novel technology to fight global plastic waste. Polyhydroxyalkanoates (PHA) might have the closest relation to plastic waste upcycling because this compound can be used as the primary material to synthesize bioplastic, so-called plastic, to the bioplastic process. Many *Pseudomonads* can natively produce PHA as their extracellular product. This study qualitatively shows that the new strain *Pseudomonas capeferrum* TDA 1 natively produces PHA from various sole carbon sources, including plastic monomers. This finding gives significant insight for many improvements to the "plastic to bio-plastic" process on an industrial scale.

## 1. Introduction

Resin, which is made from crude oil, is the core ingredient for almost all plastic products. High-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), polyvinylchloride (PVC), polyethylene terephthalate (PET), and polyurethanes (PUR) are categorized as polymer resin-based plastics [1,2]. Since plastics are used in many sectors due to versatility, plastic waste has been exponentially accumulated in the environment. The significant increase of plastic waste in the environment is due to their low biodegradability, low recycling rate, and mismanagement, which brings many environmental and health issues, such as water, soil contaminations, and diseases [3–5].

Particularly, polyurethanes (PU), mainly synthesized from polyols, isocyanates, and chain extenders, share a global production of around 27 million metric tons, making them the 6$^{th}$ most abundant polymer worldwide. However, many PU is highly stable, which is apparent that only half of the PU amount product has been generated as waste [2]. Their varied mixture and composition also cause a lack of recycling of PU. Not limited to those factors, 2,4-toluenediamine, a common precursor and putative degradation intermediate of PU, is considered a toxic compound [6,7]. While enzymatic depolymerization of ester-based PU is possible by several enzymes, such as esterase, urease, amidase,

# Gas monitoring station in hazardous environment with gases containing

**S Sendari[1]*, Y Rahmawati[1], H Rahmawati[2], D Arengga[1], F M Ramadhan[1], F Al-qodri[1], T Matsumoto[3], A Fujiyama[3], and I Rachman[3]**

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**Abstract**. Landfill sites collect tons of municipal solid waste (MSW) using an open dump mechanism, causing gases to emerge, which may cause disease and the greenhouse effect. Mainly, landfill environments are observed using a portable system that does not continuously monitor and measure emitted gas levels. It is also difficult to evaluate changes in landfill emissions over the long term unless they are monitored at regular intervals according to a detailed plan. This paper presents a new monitoring method to measure gas levels in landfill sites, which documents dynamic changes in gas composition concentrations over the long term. The system was placed in the middle area of the landfill and was charged using solar panels for convenience and greater efficiency during monitoring. While the instruments that are currently available are used for a specific parameter, this system can measure eight parameters, i.e., ambient concentration of methane ($CH_4$), carbon dioxide ($CO_2$), carbon monoxide (CO), temperature, humidity, wind direction, wind speed, and voltage level. The system was evaluated regarding its ability to monitor gas parameters continuously.

## 1. Introduction

A hazardous environment that contains poisoning gases could be harmful to people who reside nearby. One of the places which could be considered as a hazardous environment is a waste landfill site. It could also be a significant source of land, air, ground, and surface water pollution and harmful for nearby communities [1]. In Indonesia, municipal solid waste (MSW) has reached 64 million tons per year in 2017 [2]. It could be a potential problem because the open dump landfill system is mainly used. Furthermore, the statistic of the Central Bureau showed that 84.51% of MSW was disposed of without shorting it [3].

The landfill exposes various poisoning gases, such as methane ($CH_4$), carbon dioxide ($CO_2$), carbon monoxide (CO), and other gases depending on the waste mix. The potential problem of landfills could be affected by emissions of non-collected gases, where the situations depend on climate conditions. These conditions cannot be controlled [4]. Since a landfill covers a large area, and there is no gas collection system, the number of emission gases in the air should be predicted to prevent the negative