

Empowering unemployed people to process corn cob waste into briquettes as an alternative fuel in Ciherang village

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ABSTRACT

When the corn harvest season arrives, the problem in Ciherang village is that corn cob waste that becomes rubbish. The solution is these corn cobs will be made into briquettes as an alternative fuel to replace LPG gas. Unemployed youth are trained to make corn cob briquettes, starting from the theory of making them to using briquette making tools. Then field practice of the pyrolysis process, crushing charcoal, sieving, mixing, pressing, and drying the briquettes. The instructors of this activity are students taking the course MSB 398 Applications of Mechanical Engineering to Society. From the results of the training, the young people who have been appointed by the village head can make corn cob briquettes correctly and can also provide input that supports the process of making these briquettes better and produce larger quantities in a faster time.

Keywords: *Corn Cobs, Ciherang Village, PKM Itenas, Briquettes*

1. INTRODUCTION

The main function/duty of a lecturer is to carry out the development of the Tri Dharma of Higher Education activities (education, research and community service). This community service activity is funded by the Directorate of Research, Technology and Community Service, Ministry of Education, Culture, Research and Technology in collaboration with LPPM Itenas. Activities in the form of training and application of educational/research results in an effort to provide empowerment/renewal to a group of people in accordance with the scientific field of mechanical engineering. This activity was carried out in Ciherang village.

Ciherang Village is a village in Nagreg sub-district, Bandung, West Java, Indonesia. This village was a division of Ciaro Village in 1983. Currently, the village head is Mr. Toufik Mukti Ismail, ST for the 2019-2024 period. Geographically, Ciherang village is approximately 40 km from the Itenas campus, precisely on Jalan Raya Bandung-Garut KM 41,200 no.2014 or a distance of 43 km east of Bandung City. From the topography, the height of the Ciherang Village area is 948 meters above sea level with an average daily temperature of 24°C.

From education data, the average resident of Ciherang village is a high school graduate and only 2.5% go on to college. So if you look at the employment data (Figure 1), many of the population do not or have not worked, namely 19.69%. From this data, the number of

unemployed people is quite high in the productive age group, this is because many people have only graduated from elementary school, so it is difficult for them to get permanent work. The productive population does not have a clear job, because they do not have the skills. In particular, there is a feeling of inferiority in applying for work, so that many young people sit or hang out at village intersections, making it unsettling or they become daily workers, namely garden farmers.

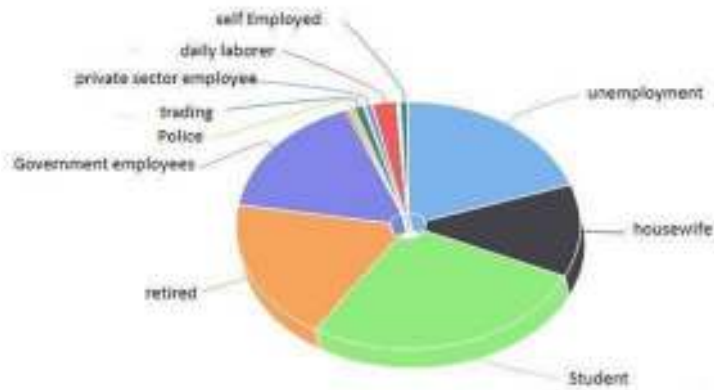


Figure 1. Ciherang Village Population Data.
 . (<https://ciherang-nagreg.desa.id/first/statistik/13>)

The potential in agriculture and plantations is very large. Ciherang village's agricultural commodities are dominated by corn, cassava, red beans and peanuts

Table 1. Ciherang village plantation commodity results 2020-2022
 (<https://ciherang-nagreg.desa.id/first/statistik/13>)

corn	660,00 Ha	3.600,00 Ton/ha
sweet potato	65,00 Ha	325,00 Ton/ha
chili	6,00 Ha	20,00 Ton/ha
peanuts	660,00 Ha	450,00 Ton/ha
long beans	45,00 Ha	10,00 Ton/ha
red beans	680,00 Ha	560,00 Ton/ha
rice	5,00 Ha	70,00 Ton/ha
Cassava	680,00 Ha	1.600,00 Ton/ha

In 2020-2022, the corn harvest in Ciherang village reached 3600 tons/ha from a total corn plantation area of around 660 ha. The harvested corn is harvested and dried in the sun in front of the yard, after drying it is immediately sold to consumers who will be used as animal feed and the sweet corn is dried as raw material for snacks such as brondong. Corn kernels that have been shelled will leave corn cobs behind. Corn cobs are stored food for the growth of corn kernels as long as they are attached to the cob. The length of corn cobs varies between 8-12. According to **(Koswara, 1986)**, corn contains approximately 30% cobs and the rest is seeds and skin. According to Maynard and Loosli, weevil consists of 35.5% crude fiber, 2.5% protein, 0.12% calcium, 0.04% phosphorus, around 44.9% cellulose content, 33.3% lignin content and the remaining 38.16% other substances.

The protein and carbohydrate content in the form of monosaccharides, disaccharides or polysaccharides found in corn cobs is high in nutrition. When the harvest season arrives, some of these corn cobs are used as additional ingredients for animal feed because corn cobs contain various types of amino acids, complex carbohydrates, proteins and minerals such as iron, manganese, calcium and other types. This source of nutrition is very important to

facilitate the absorption of nutrients in animal digestion. However, not all of these weevils are utilized properly and this is always a problem. increases because increase in agricultural land, from each It is estimated that 40% of the harvest is in the form of waste (Kalsum, 2016).

During the survey, the results of an interview with the village head, Mr. Toufik, stated that one of the problems in Ciherang village is that corn cobs that are not used will become waste or rubbish which will disturb the cleanliness of the environment and if it rots, it will spread an unpleasant odor so that it can cause disease. local people. During the field inspection, what the village head said was true, that the corn cobs were simply thrown away in front of the house, some were collected in sacks in the hope that someone would take them to use as animal feed or crafts and some were thrown into the river (Figure 2). Corn cobs that are thrown into the river will affect the river flow and the cleanliness of the river water, where some residents use the river water for bathing and washing.



Figure 2. Corn cob waste is thrown away in rubbish dumps, thrown into rivers and thrown away on the side of the road.

Another problem is that there are residents of Ciherang village lives in the plantation.(Figure 3).The only way to get reach their village to carry harvest approximately 2 – 3 Km using motorbike only. The problem is no nearest goods shop to meet daily needs especially to buy LPG for cooking, and its their get by walking around 2 – 3 Km or sometimes need extra money for public transportations like "Ojek".



Figure 3. Ciherang Village on the middle of plantations and far away from main road.

Due to that problem, Based on our observation lot of people Ciherang village using alternative fuel such as wood but when the reany season has come it will be difficult to find the dry wood for cooking. So Ciherang village have three urgent problems that needs immediately solutions

i.e. unemployment, corn cob waste and how to difficult to get LPG gas for daily use. To solving corn cob waste problem is by uprading skill program of productive youth unemployment in Ciherang village to utilize the corn cob waste to substitute LPG for daily needs.

2. METHODOLOGY

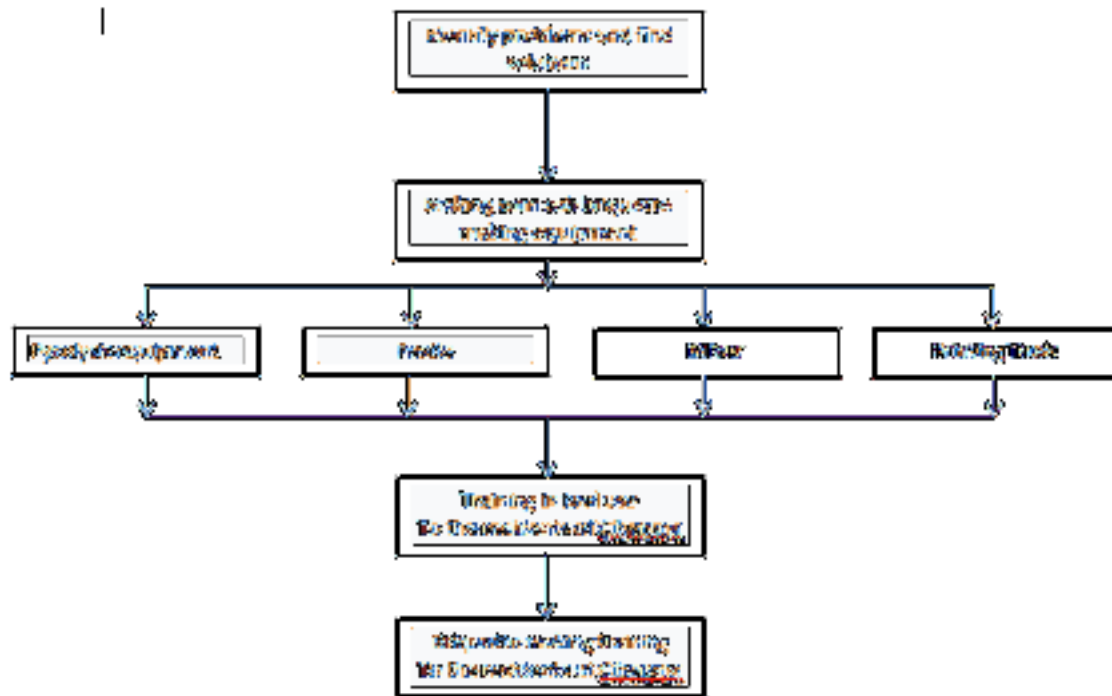


Figure 4. Activity Flowchart

The corn cob briquettes is classified as charcoal bio product and it can be used as high quality alternative fuel that has heating value (HV) reach 3500 – 5000 Kal/g. (Lilih and Budi, 2017), less vapour or smells when burned so it's safe for used even if for kitchen that don't have adequate ventilation. It's no need lots supplied of air from fan when production so we can say its depends on chemical reaction from the material it self, offcourse its also using simple production equipments.

Briquettes are lumps of charcoal made from hardened soft materials. Factors that influence the properties of charcoal briquettes are the specific gravity of the material or specific gravity of charcoal powder, fineness of the powder, carbonization temperature, compression pressure, and mixing of the briquette raw material formula (Nining, et al, 2016).

The process of making biobriquettes is very easy and simple. Starting with collecting basic materials in the form of corn stalks. Next is the process of carbonizing the corn stalks. After completion of cooking, the basic ingredients are ground until smooth. The material is then filtered so that the resulting granules are soft and have the same particle size, then mixed with the adhesive (Saleh, 2013).

Corn cob briquettes production process is made from corn cob waste to charcoal by pyrolysis process, then it ground to 30-50 mesh size. Tapioca used as adhesive is of high quality with of composition 95% :5 %, and it will produce dampness 3,67% and 11,01% volatile matter,

80,52% fixed carbon and 11,01% highest heating value (HHV) that meet SNI 01-6235-2000 standard briquettes (**Lilih and Budi, 2017**). Conventional pressing tools is used to get 3cm x 3 cm size of briquette and the structure solidity, shape also HHV of briquette depends on this process wherein High structure solidity value and shape will produced good HHV of briquettes (**Liu, 2000**).

Drying process throughout 2 – 3 days using Sun Irradiation to get briquettes are ready for daily use as an alternative fuel (**Aryani, 2017**). All equipment on this process build by "Proyek Rekayasa Sistem Mekanikal" and Final Project of Bachelor college Itenas Bandung student program that is easy to use , such as Pyrolysis Reactor, mashing tool, mixing tools, konvensional pressing tool.

- **Pyrolysis Reactor.**
Pyrolysis Reactor is equipment that use for less oxygen combustion chamber. Cleaned corn combs put into pyrolysis furnace to get carbonized charcoal. Based on research pyrolysis increase calorific value up to 6700 Cal/gr and it exceed 5000 Cal/gr based on SNI Standard (**Arman, et al, 2017**).
- **Mashing Equipment.**
Mashing equipment that use in this project still conventional no need motor or electricity to operated, bicycle design concept because a lot of people there has no electricity source. It use to get charcoal fineness powder 30 – 50 size of mesh after shifting process when Charcoal fineness highly ensure highly solidity (density) highly calorific value (**Syamsiro, 2007**).
- **Mixing Equipment.**
Conventional mixing equipment is used in this proses offcourse no need electricity. 5 Kg production capacity of charcoal fineness, Tapioca as adhesive addition to increase physical properties of briquettes with the right composition, 5% based on research (**Lilih and Budi, 2017**).
- **Pressing Equipment.**
Manual operating pressing equipment using lever mechanism. Pressing process will vary solidity and shape compact when high solidity will produce highly calorific value.

3. RESULTS AND DISCUSSION



Figure 5. Briquettes Production Training Program was opened by local government.



Figure 6. Explanations Corn Cob Briquettes Production Process.



Figure 7. Pyrolysis, and Charcoal Mashing Process.



Figure 8. Mixing Charcoal Powder with Tapioca as adhesive and Pressing Process of Corn Cob Briquettes.

Briquettes Production Training Program was opened by local government "Camat Nagrek" Enjang Wahyudin and Taufik Mukti ismail as a cheaf of Ciherang Village (Figure. 5) and then basic theory explanation about corn cob briquettes delivered by "Aplikasi Teknik Mesin Pada Masyarakat" student course from "Prodi Sarjana Teknik Mesin, Itenas Bandung". There are seven bachelor student that has responsibility to explain how to using and maintenance all briquettes production equipment are also be as briquettes production field instructor (Figure 6).

It's begins with corn cob drying process then inserting dry corn cob to pyrolysis furnace around 3 hours process to get the finest charcoal, and during pyrolysis, oxygen consumption is kept low by sealed all air gaps using clay as isolation material and inside furnace temperature are maintained approximately at 600 °C (Figure 7). The next process is mashing the charcoal using mashing tool to get 30 – 50 charcoal powder after that mixing it with Tapioca with ratio 95% : 5% inside the mixing equipment (**Lilih and Budi, 2017**). Mixing process will done if only the entire mixture turns gray and then hot water added and the mixture will look like condensed after that it's put in pressing equipment to get solid and compact shape of corn cob briquettes (Figure 8).

The Local Government said to the participant to take activity focus and seriously so they can develop corn cob briquettes business because Ciherang village is one of the largest corns produce in east Bandung. There are seven participants totally take place on this training program, the youth "Karang Taruna" Ciherang Village member at the productive age which is four of them assign by Chief of Ciherang village to takes the responsibility to produce corn cob briquettes not only to meet daily needs but also to provide employment opportunities for others. Participants also provided with a Briquettes Production Process Module containing steps making corn cob briquettes and how to use all equipment in briquettes production.

Pyrolysis Reactor has 10 Kg dry corn cob capacity and produced 7 Kg Charcoal, 30% decreased and turn into ash. Charcoal have a finest surface and fatigue structure.

Mixing equipment make mixing process between finest charcoal powder with Tapioca as adhesive material to get homogenous mixture is easily to do especially for a large production capacity, but not easily to determine the ratio of amount hot water added to get thick mixture of briquettes because if the amount of hot water is excessive it will become to sludge and it's will difficult to press the material, on the other hand if the amount of hot water too low than the mixture will be non-homogenous.

Pressing process must be as fast as possible to do when the mixture already condensed and thick in order to produce solidity of briquettes and easily pressed. One cycle produced 88 of 3cm x 3cm x 3cm corn cob briquettes and it needs 5 minute and the results are dried using sun irradiation for 4 – 5 days and it will be 50 % decreased of weight based on observation result.

Participants admitted that they were very enthusiastic about knowing how to produce corn cob waste into more economical materials after participating in the Briquette Production Training Program, moreover, this will solve the corn cob waste problem and can increased the economic incomes of Ciherang village.

4. CONCLUSIONS

The Conclusion that can be drawn from this activity are as follows:

1. Bachelor student of "Prodi Sarjana Teknik Mesin Itenas Bandung" have a real case of their science and knowledge, starting from equipment design then production/construction all equipment for making corn cob briquette, all process are carried out by them self as a team such as drawing, cutting, welding and machining.
2. All Equipment created by students for making corn cob briquette have a good function and easily to used by Ciherang villager especially participants while training program.
3. All Equipment created by Students can make corn cob briquette more faster, efficient and increased the quantity production of briquette.
4. The participants of this program especially four of them assigned by chief of Ciherang village has completely known how to making corn cob waste into alternative fuel and economical materials that can increase their daily income.
5. Badan Usaha Milik Desa (BUMDES) agree to provide a room to create corn cob entrepreneur room to prepare briquette in large quantity of production so it's can be solve unemployment problem on Ciherang village.
6. Local government will create corn cob waste Bank to accomadate it as briquette material.

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