Application of coconut paper motor speed control technology for increasing coconut liquid organic fertilizer productivity

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ABSTRACT

Coconut trees cover 90% of the agricultural land in Kadigunung Hamlet, Hargomulyo Village, Kulon Progo Regency, Yogyakarta Province, Indonesia. The livelihoods of its residents are farmers and coconut sugar grinders. Mountainous coconut husks are not used and are piled up in people's yards, resulting in an unhealthy environment due to the moldy husk. However, they still have difficulty peeling the coco coir or separating the coir from the coconut shell. Furthermore, people have been unable to package liquid fertilizer (POC) products in attractive packaging with trademarks expected to be commercialized. The Community Partnership donated a coconut coir peeling machine to increase the productivity of processing unused coconut coir waste into higher-use-value products to the market. This service program also aimed to educate people to make Kadigunung Hamlet a clean environment by empowering residents to process waste independently, thereby increasing community environmental awareness. The Community Partnership Service resulted in appropriate technology implementation, a liquid fertilizer processing (POC) module from coconut coir raw materials, POC packaging, and trademark labeling, proceedings of the ISBN Community Service national seminar, articles in reputable national journals (indexed by Sinta), POC Making Module copyright, videos of service implementation, and news in the mass media.

KEYWORDS
Coir;
POC;
trademark;
PKM

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1. Introduction

Coconut cultivation has a high potential in Kadigunung Hamlet, Hargomulyo Village, Kokap District, Kulon Progo Regency, and D.I. Yogyakarta because 90% of the agricultural land is planted with coconut trees. Residents make a living as farmers and coconut sugar grinders. However, coconut coir is not used but piled up in the residents' yards. There are two farmer groups in the hamlet, the Makmur Farmer Group and the Sedyorukun Farmer Women's Group. With the initiation of the community partnership program (KKN-PPM grant program) within the Muhammadiyah University Yogyakarta, the manufacture of organic fertilizers was established. The donated coconut coir chopper machine for the process of making Liquid Organic Fertilizer can be arranged at different speeds.

Several studies on motor speed control have been conducted to support this community service. Linares-Flores used a combination of a solar-powered boost converter and a voltage-source inverter to control the induction motor's angular speed [1]. In his research, Sun proposed a low-speed sensorless control method of brushless DC motors based on high-frequency pulse voltage injection [2]. Kumar used a PID controller for pressure control of a fixed-displacement variable-speed radial piston pump [3]. Ben Abdeljawed researched DC-powered universal motor speed control simulation and prototype for more efficient operation in future DC homes [4]. Boztas implemented sensorless synchronous reluctance motor speed control using an extended Kalman filter [5]. Zerzeri examined the optimal

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speed-torque control of a two-feed induction motor using analytical and graphical methods [6]. Mukhopadhyay investigated ANFIS-based speed and current control by minimizing torque ripple using a hybrid SSD-SFO for an activated reluctance motor [7]. S. El Daoudi used a sliding mode speed controller sensorless fuzzy direct torque control of an induction motor [8]. Gamazo-Real estimated position and speed sensors for BLDC motors using ANN-based estimation [9]. M. Senthilkumar designed and developed an intelligent controller for the speed control of a special electric motor [10].

Yang investigated sensorless speed control of a bearingless induction motor using a sliding mode observer and a phase-locked loop [11]. Arpit used a field-oriented control method for the forward speed control of a three-phase induction motor [12]. Using the simultaneous speed and torque control method, Boloor Kashani investigated the reduction of torque ripple in a BLDC motor drive without an electrolytic capacitor [13]. Cabré explored a didactic platform for DC motor speed and position control in the Z-plane [14]. Truong analyzed the thermally affected high-speed spindle with angular contact ball bearings [15]. Zhao investigated a neuroadaptive dynamic control surface for an induction motor stochastic system based on a reduced-order observer [16]. The vestibular and visual, written by Hennestad, contribute to angular head velocity tuning in the cortex [17]. The effect of increasing velocity on the angular momentum of the entire body during stride in the elderly was studied by Begue [18]. Zhang analyzed the control of burst oscillations in a fractional-sequence permanent magnet synchronous motor system [19]. The effect of motor skill level and speed on movement variability during running was studied by Wang [20].

Gundogdu examined the NARMA-L2 controller for stepper motors used in single-link manipulators with low-speed resonant damping [21]. Zhi investigated the interval linear quadratic regulator and its application for DC motor speed control in the presence of uncertainty [22]. The fatigue cracks in high-speed rail hanger motors, as researched by Mao are caused by current fluctuations [23]. Zhao investigated the fault tolerance control of the clutch actuator motor in a 6-speed dry double-clutch transmission enhancement [24]. Bonnardot proposed the high-frequency demodulation technique for instantaneous angular velocity estimation [25]. Koláová investigated the effect of motor imagery on movement quality while performing achievement tasks in healthy subjects [26]. Bensiker Raja Singh implemented a fractional-pi controller for optimal speed control on a fed induction motor with a quasi-z-source converter [27]. J. Sawma investigated an improved anti-reverse control algorithm for gearless traction motors in elevator applications [28]. Zhong dynamic system decoupling for control of active fault rejection and energy consumption of three-phase asynchronous motors [29]. A current-controlled BLDC motor-driven hysteresis-operated matrix converter, as researched by Singh can streamline speed control and improve power quality [30].

Liu modeled an integrated permanent magnet toroidal motor drive with nonlinear electromagnetic parameters [31]. Zeng proposed the ultra-low speed driving method of a traveling wave ultrasonic motor for cmg [32]. Mahfoud improved direct torque control using artificial neuron networks for dual feed induction motors [33]. Keshavarzi dissected the multisensory coding of angular head velocity in the retrosplenial cortex [34]. Rigacci investigated the effect of a mechanical system's vibration characteristics on the efficiency of servo motors [35]. Rodrguez analyzed a bio-inspired adaptive control strategy for highly efficient DC motor speed regulation under parametric uncertainty [36]. Wu investigated driving mode shift control for a planetary gear-based dual motor powertrain in electric vehicles [37]. Huang integrated the optimal timing motion profile with position control for a planar motion stage of a high-speed permanent magnet linear synchronous motor [38]. Potnuru conducted an experimental implementation of the flower pollination algorithm to control the speed of a BLDC motor [39]. Kong studied the dynamic characteristics of a simple, supported elastic beam with three induction motors [40]. This farmer group in Kadigunung Hamlet is currently active in producing POC using coconut fiber as a raw material. However, they continue to struggle to peel the coco coir and separate the coir from the coconut shell.

The community service contributes to the enhancement of the people's welfare in Kadigunung Hamlet, especially farmer groups, by donating appropriate technology tools in the form of a coconut coir peeling machine, aimed at simplifying and increasing the productivity of processing unused coconut coir waste into products of higher value, namely ready-to-use POCs. The first method of processing coconut coir waste is peeling coconut coir, then chopping the coconut fibers into smaller sizes. The

chopped coir will then be fermented to make POC. The residents of farmer groups are trained to package products well and label them with trademarks for the market. This service program also aimed to educate people on how to make Kadigunung Hamlet a clean environment by empowering residents to process waste independently, thereby increasing community environmental awareness.

2. Method

Figure 1 depicts the design method for motor speed control. The control system consists of input, control, and output. The keypad is the input used to adjust the speed, the microcontroller is for the control, and the motor is the output.

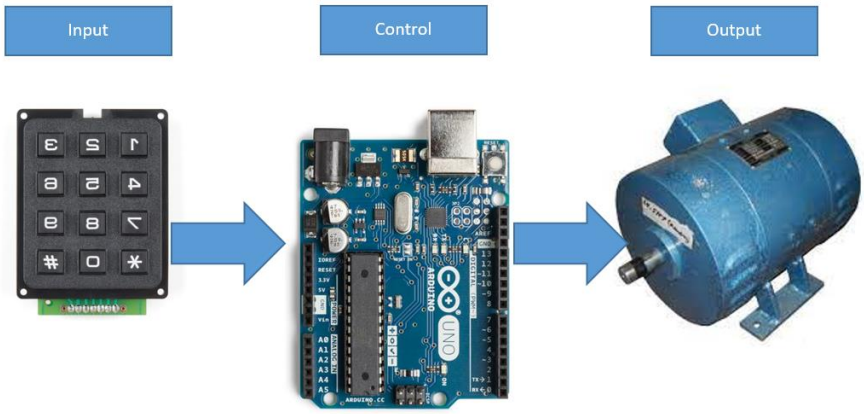

Fig. 1. Coconut Coir Peeler Machine components

The activity plans to support the community service program were:

- Collecting coconut fiber waste in collaboration with the residents of Kadigung Hamlet
- The grant of a coconut husk peeler machine to the people of Dusun Kadigunung, represented by the Head of the Farmers Group and the Head of Kadigung Hamlet.
- Counseling on the operation and maintenance of the coconut husk peeling machine
- The chopping of coco coir with a coconut coir chopper machine.
- Training on making POC at the stage of fermenting chopped coconut coir and providing knowledge in agriculture
- POC Laboratory test at Muhammadiyah University's Soil Laboratory in Yogyakarta.
- Community-made POC application on chili plants
- Brand logo creation and product packaging for the ready-to-use POC
- Trademark registration of POC products with the Directorate General of Intellectual Property Rights
- Manufacture of POC modules
- Copyright Registration in the POC Module with the Directorate General of Intellectual Property Rights
- Keeping track of the farmer group residents involved in the POC process to market.
- Program evaluation

3. Results and Discussion

The Coconut Coir Peeling Machine was given to the Kadigunung Hamlet farmer group represented by the Chair of the Farmers Group who was also the Head of Kadigunung Hamlet prior to the practice of making liquid fertilizer.

The Coconut Coir Peeler Machine was designed with dimensions suitable for the MSME scale (Micro, Small, and Medium Enterprises). The driving force for this peeler was an electric motor with a minimum power of 1 HP, an additional gearbox, and pulley technology in the power transfer system from the electric motor to the blade drive shaft on this machine. The gearbox was to increase the moment or torque obtained and make the blade shaft rotation more stable. This relatively small electric motor was connected to a power source from electricity with a power generation range of 900 watts. With this electric motor, the engine performance was better, free of air pollution, quiet with minimal vibration, and easy to maintain. The coconut peeler machine facilitated the community to carry out the coconut peeling process more easily, quickly, and efficiently. This tool could peel 300 coconuts per hour or more depend on whether the operator was skillful or not, whereas when it was done manually using a crowbar, one person was only able to peel a maximum of 100 coconuts per hour, and it took so much energy which could be spent for other activities. Figure 1 shows the head of Kadigung Hamlet accepted a coconut peeler machine from one member of community service team. The community service team member gave counseling on the operation and maintenance of the coconut husk peeler machine. It aimed to transfer the skill of operating and maintaining the machine.

Fig. 2. Grant of Coconut Coir Peeler Machine

Fig. 3. Coconut Coir peeling Process using Coconut Coir peeling Machine

The member of the farmer group collected coconuts at the house of the head of the hamlet, who was also the head of the Kadigunung farmer group, and the community team member trained how to peel the coconut coir using the machine. The coconut coir was then mixed with sugar cane water and fermented for 21 days to become liquid fertilizer. Figure 4 shows the process of making the fertilizer.

Fig. 4. POC Making Process Training for the Community

Furthermore, POC content elements were tested at the Muhammadiyah University of Yogyakarta's Soil Laboratory. The result of the test is shown in Figure 5.

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LAPORAN HASIL PENGUJIAN

ANALISIS POC

Nomor : 013/L-HA/X/2020
Nama : Pak Rinasa
Jumlah : 01 unit
Macam Uji : C organik metode Walkey & Black
N Total metode Kejdahl
P & K Total metode Extraksi HCl 25%

sample	C ORGANIK		N TOTAL	K TOTAL		P TOTAL	
	Kadar C (%)	Kdr BO (%)	(%)	K tot ppm	K Total (%)	ppm P	% P
1	0.59	1.02	0.16	1,270.56	0.13	129.02	0.01

Jogjakarta, 21 Oktober 2020

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Fig. 5. Results of Resident-Made POC Analysis Test

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Figure 6 shows the POC applications on chili plants. The purpose was to find out the effectiveness of these fertilizers on plants. The results showed that the plants had dense fruit and avoided leaf curl, a common chili disease caused by pests, the environment, and improper care.

Fig. 6. POC Application on Chili Plants

Members of the community service team conducted counseling about the importance of Brand Logos and Product Packaging. This counseling was carried out at the house of the hamlet head, who was also the head of the farmer group in Kadigunung Hamlet, as illustrated in Figure 7, by all farmer groups, both the Prosperous Forest Farmer Group and the Sedyorukun Women Farmer Group.

Fig. 7. Extension of Brand Logo and Product Packaging in the Form of Bottles for POC

The community service team helped residents register POC product brands and POC module copyrights at the Directorate General of Intellectual Property Rights, as shown in Figure 8. Trademark registration aimed to protect intellectual property for micro, small, and medium enterprises (MSMEs). Registration of Copyright for Modules was intended so that module products made by the academic community of Muhammadiyah University of Yogyakarta could be protected and became the property of the university as one of the ranking items and are also beneficial for inventors, especially the chairman and community service team, and can be used freely by residents of Kadigunung Hamlet because this is one of the grants to the community in this service program.

REPUBLIK INDONESIA
KEMENTERIAN HUKUM DAN HAK ASASI MANUSIA

SURAT PENCATATAN CIPTAAN

Dalam rangka pelindungan ciptaan di bidang ilmu pengetahuan, seni dan sastra berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, dengan ini menerangkan:

Nomor dan tanggal permohonan	:	EC00201949552, 7 Agustus 2019
Pencipta		
Nama	:	**Rinasa Agistya Anugrah, S.Pd., M.Eng., Yulianti,**
Alamat	:	Jl. Brawijaya, Geblagan, Tamantirto, Kasihan, Bantul, Daerah Istimewa Yogyakarta, Bantul, Di Yogyakarta, 55183
Kewarganegaraan	:	Indonesia
Pemegang Hak Cipta		
Nama	:	**Universitas Muhammadiyah Yogyakarta**
Alamat	:	Jl. Brawijaya, Geblagan, Tamantirto, Kasihan, Bantul, Daerah Istimewa Yogyakarta, Bantul, Di Yogyakarta, 55183
Kewarganegaraan	:	Indonesia
Jenis Ciptaan	:	**Modul**
Judul Ciptaan	:	**Mengenal Lebih Jauh Pupuk Organik Cair Sabut Kelapa**
Tanggal dan tempat diumumkan untuk pertama kali di wilayah Indonesia atau di luar wilayah Indonesia	:	26 Juli 2019, di Yogyakarta
Jangka waktu pelindungan	:	Berlaku selama 50 (lima puluh) tahun sejak Ciptaan tersebut pertama kali dilakukan Pengumuman.
Nomor pencatatan	:	000149502

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Dr. Freddy Harris, S.H., LL.M., ACCS.
NIP. 196611181994031001

Fig. 8. Copyright of POC Module

Figure 9 depicts the filling of bottles with liquid fertilizer. Fertilizers in bottles are then given attractive labels that include trademarks, compositions, and instructions on how to use them. This liquid organic fertilizer's packaging and labels are expected to boost its sales.

Fig. 9. Filling fertilizer for labeling

The next activity was evaluating the program implementation to find out how effectively it had run and how much benefit the community had received. The community was very active and enthusiastic in all community activity program activities. They were very grateful for this community service program because it increased their competence and skills in managing and processing coconut coir waste, which was a potential natural resource in Kadigunung Hamlet.

4. Conclusion

The 2019-2020 Special Fund Community Service Program by the Research, Publication, and Community Service Institute at Muhammadiyah University of Yogyakarta, Dusun Kadigunung, has succeeded in reaching the expected goal. The program implementation was planned for six months but was constrained by the COVID-19 pandemic, so it was postponed to nine months, from January 2020 to October 2020. All residents, particularly members of the Farmers Group in Kadigunung Hamlet, were very enthusiastic about receiving counseling, putting their new skills to use, and continuing this service program in the future to help build a productive economic society. The community is skilled at operating and maintaining coconut peeling machines donated by the Community Service Team, can make its POC, and knows product packaging, especially POC products. The marketing of POC products is currently limited to the Kadigunung Farmer Group and other hamlets that are also home to fellow farmer groups. The products are expected to be distributed more widely in other villages and cities.

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Author Contribution

This service program also aimed to educate people to make Kadigunung Hamlet a clean environment by empowering residents to process waste independently, thereby increasing community environmental awareness.

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Conflict of Interest

The authors declare no conflict of interest.

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