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# Empowerment of Miftahunnajah Islamic Boarding School Students in Sleman Yogyakarta with the Integrated Green Farming System

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**Abstract**
This service activity is the result of a study of the uniqueness of the electrical and chemical engineering field applied to agriculture and fisheries. The application of the system is called Integrated Green Farming (IGF). IGF is an integrated hydroponic fishery and farming system that utilizes fish waste residue as a nutritional supplement for hydroponic plants. Hydroponic plants are essential plants that can be used for essential oil production. The system is supported by a solar power generation system to work without needing an external electrical energy supply. This system is implemented in Islamic boarding school management partners to provide students with entrepreneurial skills. The stages of the activity consist of preparation, implementation and evaluation. The preparatory phase includes delivering materials related to the system to be built and preparing materials needed to implement activities. At the same time, the implementation stage is creating and maintaining a system involving students. Meanwhile, in the evaluation stage, monitoring of system performance and the success of essential plant and fish projects is carried out after three months. The result of this community service activity is the Integrated Green Farming (IGF) system which is implemented at the Miftahunnajah Modern Islamic Boarding School (PPM) partners. The IGF system is functioning properly, the essential plant of mint leaves is thriving, and the catfish is ready to be harvested. The developed IGF system can be applied to other communities/Islamic boarding schools because it is relatively easy to implement and maintain.

**Keywords:** students, integrated green farming system, essential oil plant, solar energy, fishery

## INTRODUCTION

Islamic boarding schools, as an educational institution, apply many non-formal curricula and are considered more flexible in instilling the desired character (Syafe'i, 2017; Oktari & Kosasih, 2019). This potential has also begun to be realized by the Directorate General of Small, Medium and Multifarious Industries (IKMA), which routinely holds the Santripreneur program. It is part of the implementation of the Memorandum of Understanding on the Growth and Development of Industrial Entrepreneurs in Islamic Boarding Schools (Santripreneurs) between the Ministry of Industry and the Ministry of Religion on December 17, 2021 (Kemenperin, 2022). This program has reached seven provinces in Indonesia, with its activities covering waste recycling, convection, food processing, processed coffee drinks, iodized salt, paving blocks, welding, body care products, two-wheeled workshops, liquid organic fertilizer, and footwear (Kemenperin, 2022). However, the scope of this activity has not yet expanded because it has only reached 88 Islamic boarding schools involving 10,199 students out of 4.76 million students in Indonesia who are in 33,971 Islamic boarding schools (based on data from the Ministry of Religion as of August 2021). In addition, the program developed is highly dependent on the pesantren's environmental potential, so other parties' participation is needed in the success of the character development program in Islamic boarding schools.

Data from the Ministry of Industry in 2018 shows that Indonesia needs at least 4 million

new entrepreneurs to help strengthen the economic structure. The country's entrepreneurship ratio is still around 3.1 per cent of the total population (Ministry of Industry, 2018). This figure is still lower compared to other countries, such as Malaysia at 5%, China at 10%, Singapore at 7%, Japan at 11%, and the US at 12%. So a breakthrough is needed in character education at the tertiary level in order to strengthen student character related to hard work, creativity, and independence.

Miftahunnajah Modern Islamic Boarding School (PPM) is an integrated boarding school with MTs and MA. Miftahunnajah's vision is to become an integral educational institution at the forefront of educating the Qur'anic generation who are sensitive, creative and productive. Madrasah Aliyah Miftahunnajah is an advanced level of MTs Miftahunnajah, which was founded in 2018. In 2021, it will be accredited for the first time with an A (Excellent) grade and graduate students with outstanding achievements. It has been proven that most students memorize 30 chapters of the Qur'an and successfully continue their studies at public and private universities. Currently, there are 132 students at MA Miftahunnajah. The flagship programs of the Miftahunnajah Islamic Boarding School are the Boarding School Program, the Al-Qur'an and Hadith Tahfizh Program, the Arabic and English Language Program, the Kitabah Arobiyah Program, and the Digital Islamic Boarding School Program.

In accordance with Miftahunnajah's vision of educating a sensitive, creative and productive Qur'anic generation, one of Miftahunnajah's PPM programs is to build a spirit of independence and entrepreneurship for students. However, the program could have run better due to limited learning media and human resources.

Department of Chemistry, Universitas Islam Indonesia, has an MoU with PPM Miftahunnajah number 001/Kajur.Kimia/10/JurKim/UII/2020 covers education, research and community service activities. The activities that have been carried out are in the field of education, namely students doing a practicum in the Department of Chemistry, UII laboratory, including Essential Chemistry laboratory, UII.

The link between the previous coaching program that was carried out by the Department of Chemistry at the Islamic UII to PPM Miftahunnajah was to continue the students' education program with the community service program at the Department of Chemistry, UII. Several alternative solutions that might be implemented to empower students to develop entrepreneurial character include entrepreneurship material training activities, visits/comparative studies, and practical skills. Students consider Entrepreneurship material training activities boring and quickly forgotten, while the second alternative, visits/comparative studies, is considered more attractive. However, visiting/comparative study activities require financial support, which is not negligible and will become mere student memories. So, the alternative chosen in this activity is the provision of practical skills.

The community service program that will be carried out is the empowerment of Miftahunnajah Islamic boarding school students with practical skills related to the Integrated Green Farming (IGF) system. This activity is by the curriculum and work program of the Modern Miftahunnajah Islamic Boarding School, especially regarding fostering the character of independence and entrepreneurship of students through the IGF program. The IGF program is an integrated system in which hydroponic and fish-essential plant cultivation is carried out simultaneously by utilizing a solar power plant (PLTS) to run the IGF system (Fitri & Dadang, 2015). The IGF system is environmentally friendly because it utilizes solar energy to drive water pumps and circulate water to fish ponds. Then the water from the fish pond is channelled into the hydroponic system. Water from ponds carries fish waste which can be used as organic fertilizer for hydroponic plants. The water flow from the hydroponic plants is returned to the water tank. In addition, PLTS energy is also used to run hydroponic system automation programs. Thus, the costs of cultivating plants and fish can run more effectively and efficiently and be environmentally friendly. Figure 1 shows the design of the IGF system.

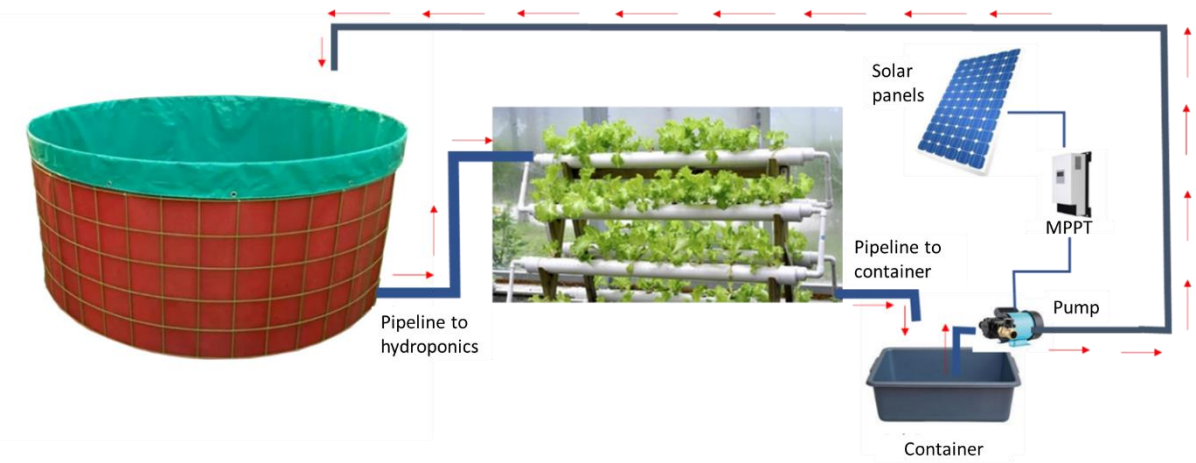


Figure 1. The integrated green farming system for empowering students

Renewable energy from the sun through solar panels in agriculture has been widely applied. The application of an aquaponic farming system with an independent energy source using solar panels has been implemented (Apripriharta et al., 2022), (Demeianto et al., 2021), (Setyohadi et al., 2020), (Rohman et al., 2021) is even integrated with a fishing pond system to save energy (Nurhaidah et al., 2022), (Setiawan & Pramono, 2023). The advantage of using renewable energy from the sun is avoiding dependence on energy sources from fossils and maintaining the sustainability of its energy supply at all times. In addition, economic benefits will be obtained by saving on energy costs (Nurhaidah et al., 2022). A one-line diagram of the PLTS electricity system is shown in Figure 2.

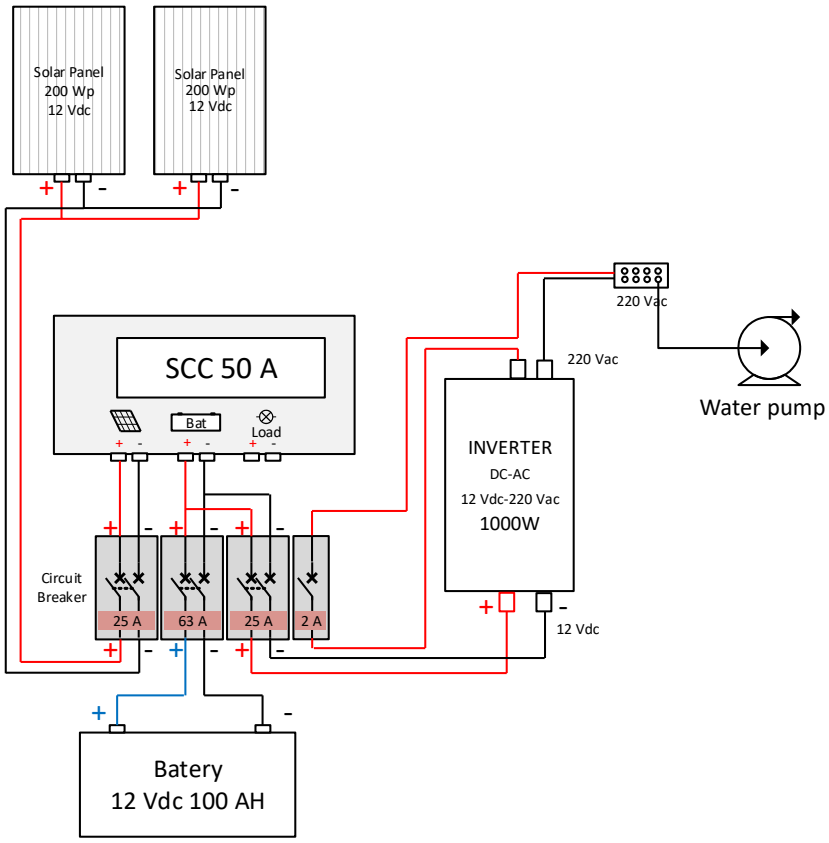


Figure 2. One-line diagram for a solar panel electrical system

Hydroponic farming systems that are integrated with fish ponds require that the water media always flow. The water will carry fish waste to be distributed throughout the plant as

nutrition. Electrical energy in a hydroponic farming system that is integrated with fishing ponds is used to drive water pumps. Therefore, to meet the need for electrical energy in this system, an energy source can supply continuously without having to depend on energy sources from PLN.

Based on data on the Solargis website, 2018, Indonesia has enormous potential for sunlight, around 3.6 – 6 kWh/m2/day. With this potential, the average area in Indonesia gets 1,170 – 1,530 kWh of solar energy per year. According to Nayak, 2019, this potential should be considered and developed as an alternative source of electrical energy. Compared to the development of the implementation of PLTS in the world, the trend of PLTS in Indonesia is considered slow. According to IRENA data, 2022, the increase in PLTS from 2020 to 2021 is only 26 MW, with a total capacity of 211 MW. This value is far below other new renewable energy (EBT). For this reason, efforts are needed to increase the use of PLTS, including for productive activities such as fishing and agriculture.

The number of Islamic boarding schools in Indonesia has reached 33,971. Several benefits will be obtained if half of these Islamic boarding schools apply the IGF system with the proposed specifications.:

(1) The PLTS capacity installed due to this activity reaches 6.7 MWp
(2) Fishery production increases by around 1,700 tons per year
(3) Essential plant production increased by around 169 tonnes per year
(4) Increasing the economic capacity of Islamic boarding schools
(5) Improving the health of students

## METHODS

This dedication is a combination of qualitative and quantitative dedication. The qualitative aspects are related to perceptions and reflections before and after the activities. At the same time, the quantitative aspects are related to the technical and economic results of the activities carried out.

In general, there are three main steps in this community service activity, namely: preparation, implementation and evaluation, as illustrated in Figure 3 below.

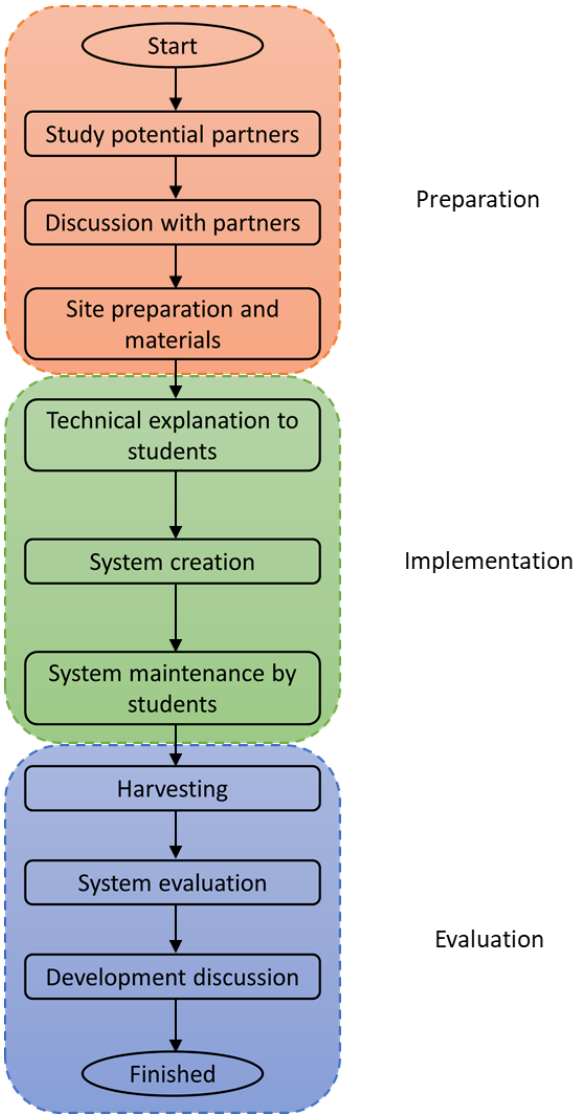


Figure 3. Stages of community service activities

The preparatory stage includes studying potential partners related to the types of plants and fish to be cultivated. Furthermore, discussions were held with partners to obtain an agreement regarding the technical details of the activities to be carried out. In addition, it was also agreed that the location would be the place for implementing the system and procuring the necessary materials.

At the implementation stage, the service team explains the technical stages of making the system to the participating students. Next, a schedule of stages and students who will be in charge of helping make the system is made until it is finished. After the system is ready, the service team explains to the students the maintenance of the system that has been created so that they can work independently. So that in maintenance, the whole responsibility lies in the hands of the Santri.

At the evaluation stage, all parties witnessed the harvesting of the previously attempted results, including freshwater fish and essential plants. Harvest values are converted to rupiah to obtain economic value from implementing this system. The data obtained is used for discussion with partners for future development.

**Solar Panel Circuit Installation**

This energy supply system from the sun uses an off-grid system, so batteries are needed for energy storage, especially when no sunlight can be converted into electrical energy. The battery used has a voltage specification of 12 V dc, 100 Ah, lithium type, which is equipped with

a battery management system (BMS). The BMS regulates and distributes the process of charging and discharging energy to each battery cell so that it remains evenly distributed and safe.

Charging from the solar panel to the battery is controlled by the solar charge controller (SCC). The main function of the SCC is to regulate the process of charging and discharging the battery. In addition, SCC is equipped with a battery temperature detection system, overcharge protection system, short circuit protection system, lightning protection, reverse polarity protection, reverse discharge protection and under voltage protection. This SCC specification has a nominal charging current of 50 A and a discharge current of 20 A with a maximum input power of 650 W at a voltage of 12 V dc. SCC uses a maximum power point tracking (MPPT) system to improve battery charging efficiency.

The conversion of dc to ac voltage is carried out using an inverter with an input voltage of 12 V dc to a voltage of 220 V ac, 50 Hz. At the same time, the circulation water pump uses a power of 25 W with a thrust capacity of up to 1.8 m. The protection system against short circuits and overload using a mini circuit breaker (MCB) is placed between solar panels and an SCC of 25 A, between an SCC and a battery of 63 A, between a battery and an inverter of 25 A and between an inverter with a load of 2 A. The battery components and BMS, SCC, inverter and security system are placed in a panel box with dimensions of 40 × 60 × 20 cm. The solar panel has a 400 Wp monocrystalline type capacity, consisting of 2 solar panels of 200 Wp each. The current at maximum power is 10.96 A at a voltage of 18.24 V for one solar panel. These two solar panels are arranged in parallel to obtain a higher current.

## DISCUSSION

The results of the preparatory phase include discussions with partners regarding the types of plants to be planted, namely mint leaves, and fish to be cultivated, namely catfish and discussions regarding the technical details of the activities carried out during the teaching and learning schedule shown in Figure 4. In addition, it was also agreed the location where the system will be implemented is shown in Figure 5, and the procurement of the required materials is shown in Figure 6.

Figure 4. Discussion with Partners

Figure 5. System implementation location

Figure 6. Purchase of Mint leaf seeds

The service team carries out the implementation stage by explaining the technical stages of making the system to the students who will participate, as shown in Figure 7.

Figure 7. The technical explanation for making the system

After the explanation, the students made a series of solar panels, while the female students

made a series of hydroponic installations and prepared the planting media, as shown in Figure 8.

(a) (b)

(c)

Figure 8. Making (a) a series of solar panels, (b) a hydroponic installation, and (c) a planting medium

After the system is ready, the service team and the students install the system at the chosen location and explain to the students the maintenance of the system that has been made so that they can work independently, which can be shown in Figure 9.


Figure 9. Installation of a hydroponic system in a fish pond

Mint leaf seeds are then planted in the growing medium installed in the hydroponic installation shown in Figure 10.


Figure 10. Planting Mint Leaves

After the entire series of implementations has been completed, a handover is carried out by installing the nameplate that has been prepared (Figure 11).

Figure 11. Signpost installation and approval

At the evaluation stage, all parties witnessed the harvesting of the previously attempted results, which included freshwater fish and essential plants shown in Figure 12.

Figure 12. Cultivating Mint leaves with an integrated green farming system

**Energy Calculations**

It is assumed that exposure to sunlight is practical for 5 hours per day so that with a solar panel capacity of 400 Wp, 2 kWH of energy will be obtained. This energy is used to charge the battery and supply the water pump. Charging a battery with a voltage of 12 V and a capacity of 100 Ah requires 1200 Wh of energy. Meanwhile, the energy requirement for a 25 W water pump

for 24 hours is 600 Wh. The Depth of Discharge (DoD) of a lithium-type battery is 80%, so the battery's stored energy that can be used is 960 Wh. The pump can use this energy for 38 hours without any energy from the solar panel. Meanwhile, the losses in the converter (SCC and inverter) with an efficiency of 65% are 200 Wh for 24 hours. If the conditions are normal with sun exposure of 5 hours per day continuously, then the energy flow is shown in Figure 13.

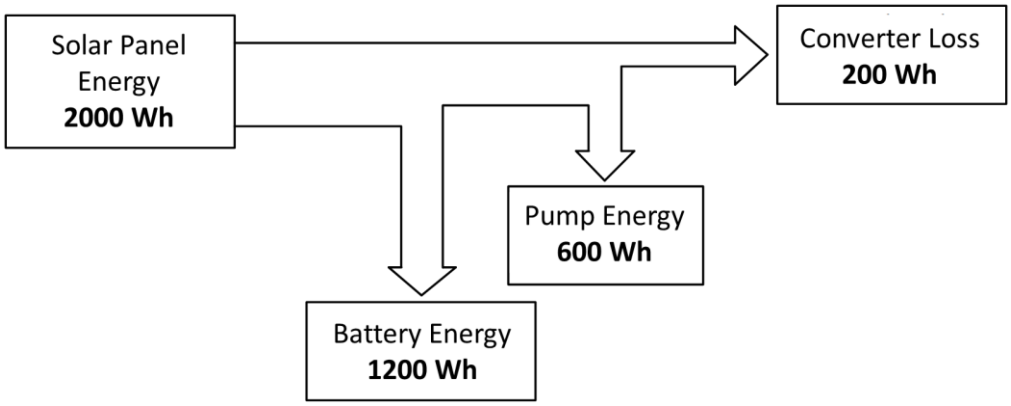


Figure 13. The energy flow from a solar panel system

Based on Figure 13, this system can continuously supply energy for the pump. If there is no sunlight that solar panels can convert, the battery can supply the pump continuously for 38 hours.

## CONCLUSIONS

The developed IGF system has been successfully implemented at Miftahunnajah partner Islamic Boarding Schools, Sleman. The application of this system is full of knowledge for students, namely the application of physics, mathematics, chemistry, biology, and environmental science. In addition, the IGF system trains students' entrepreneurial soft skills by utilizing solar energy for integrated agricultural and fishery cultivation by applying advanced technology. The IGF program will continue to be monitored and developed by implementing the Internet of Things (IoT) system so that monitoring and controlling the IGF system can be carried out remotely in real-time.

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